...NOLOGY DEPT.

Gas Journal

INSTITUTION NUMBER

VOL. 290. 109th YEAR. LONDON, MAY 22, 1957. Nº 4897. PRICE 2/6

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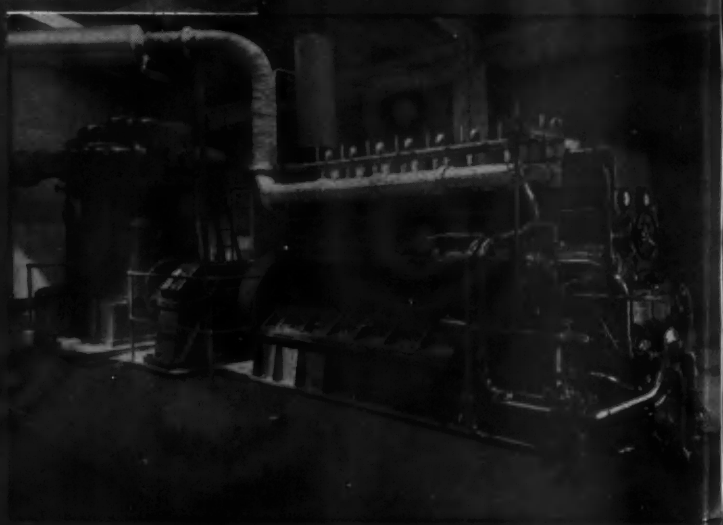

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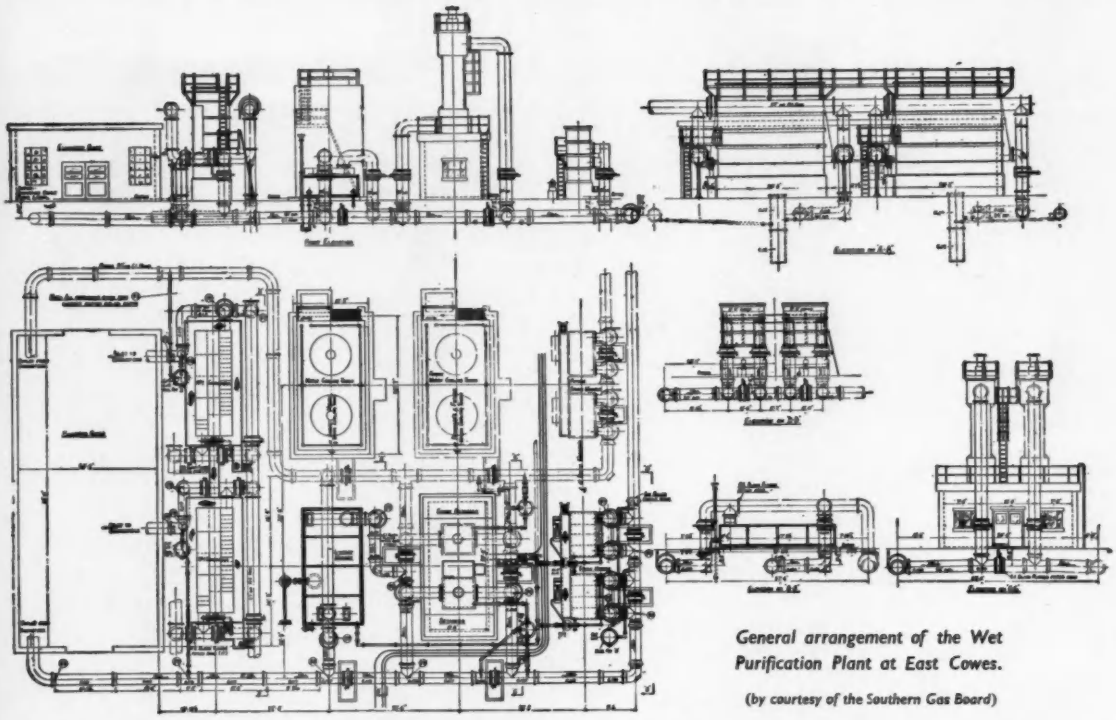

General arrangement of the Wet Purification Plant at East Cowes.

(by courtesy of the Southern Gas Board)

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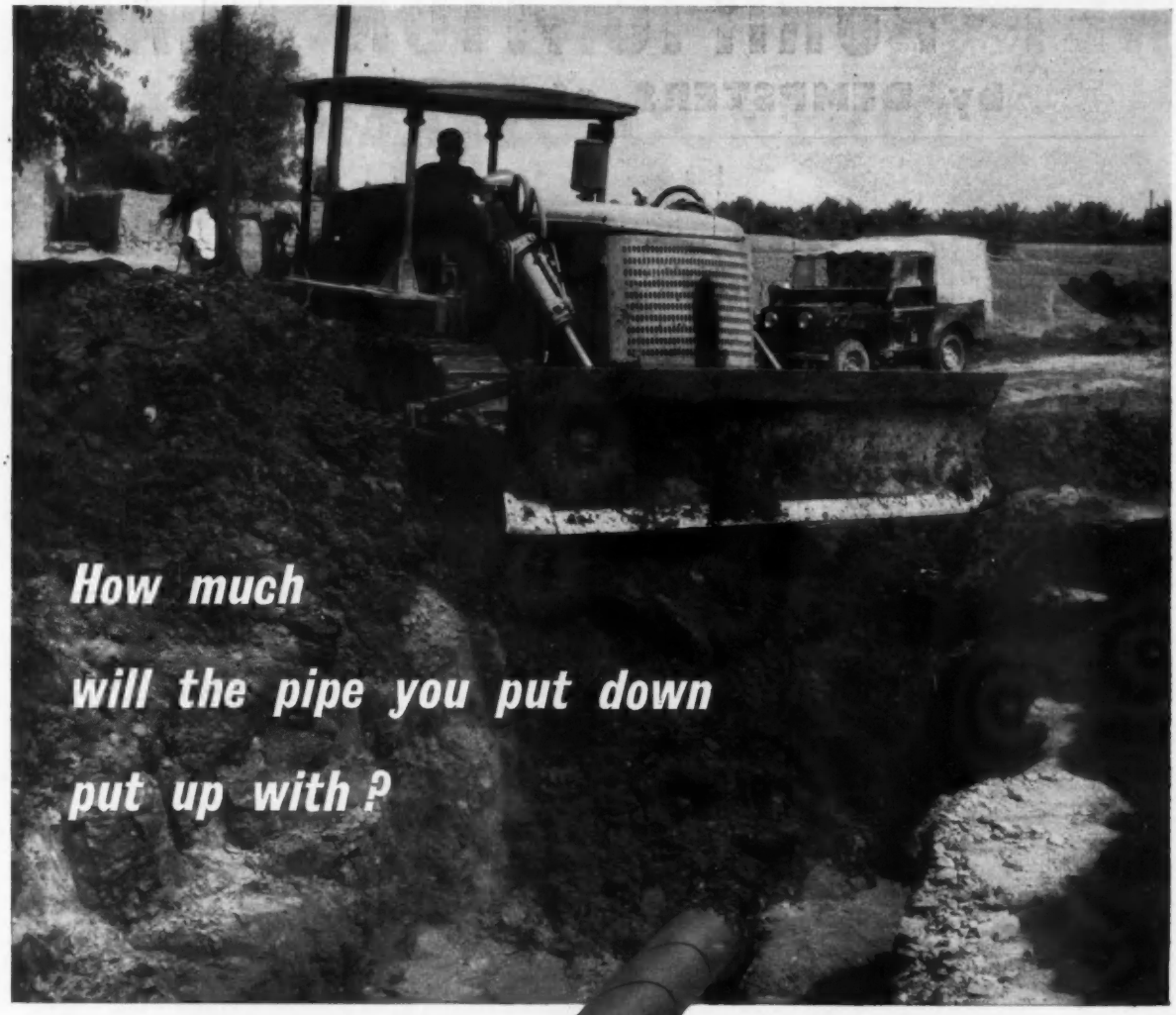

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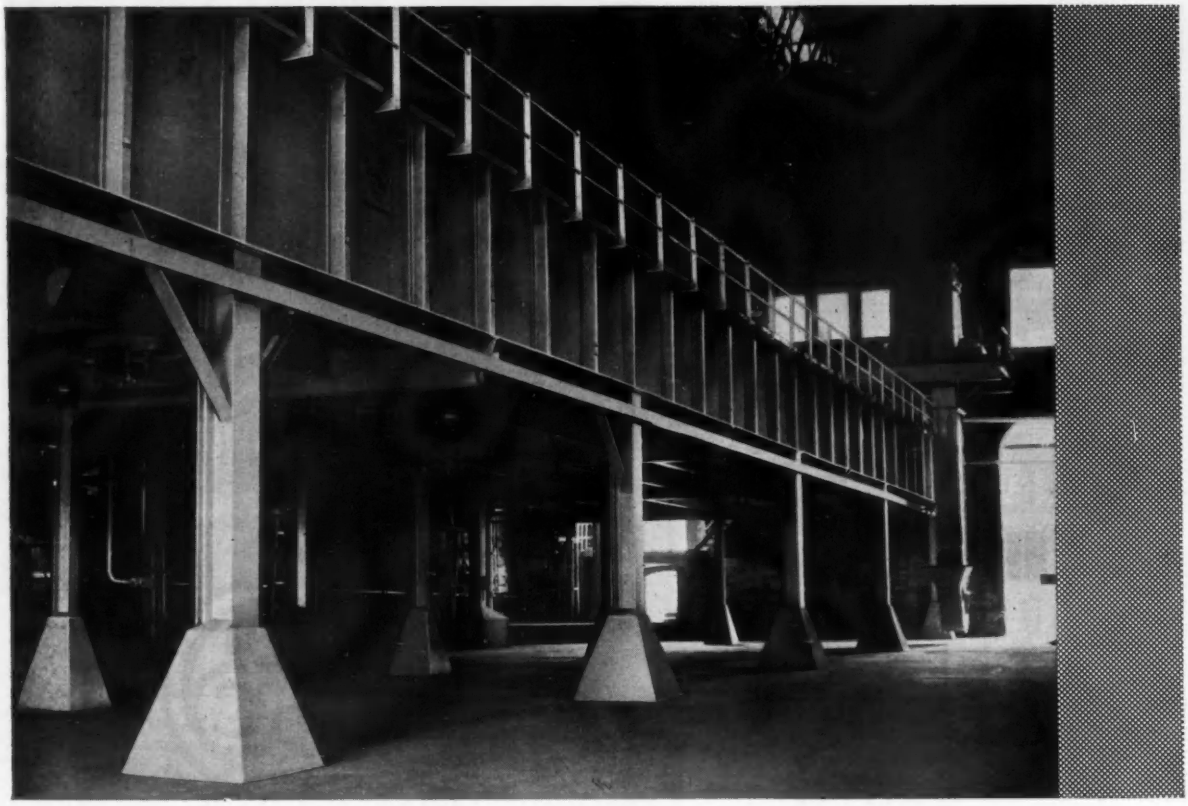

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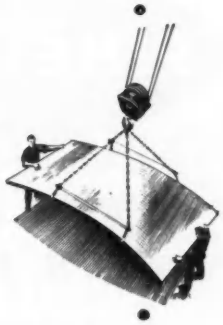

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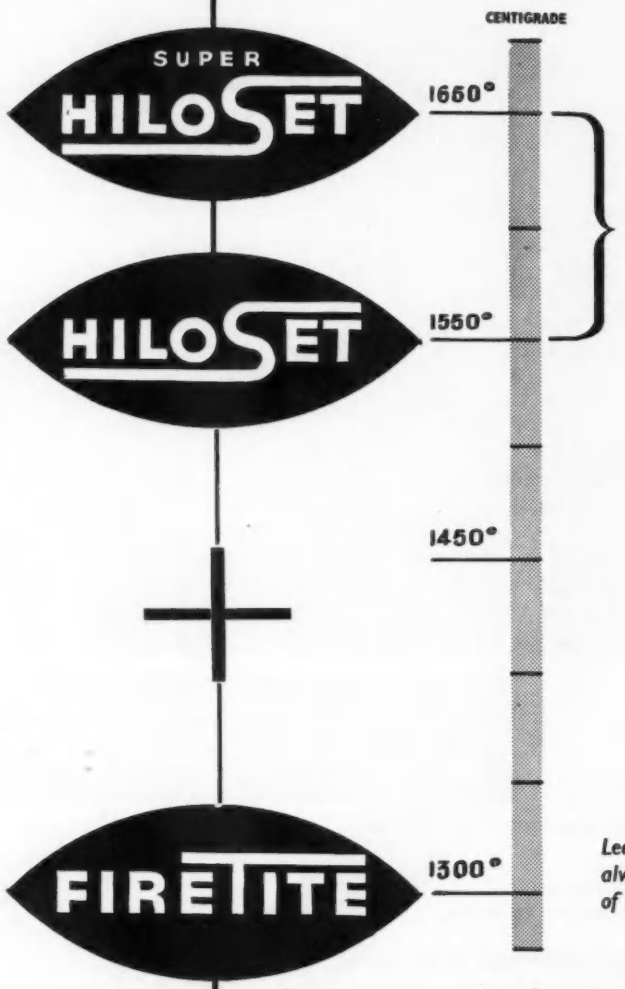

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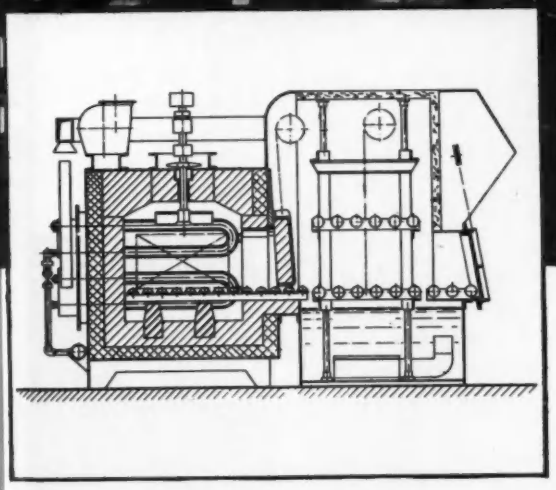

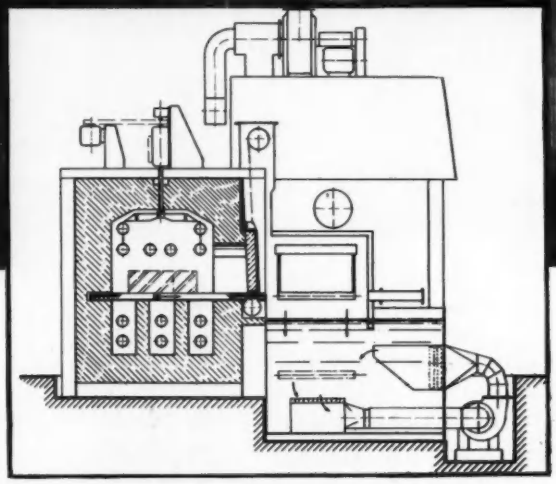

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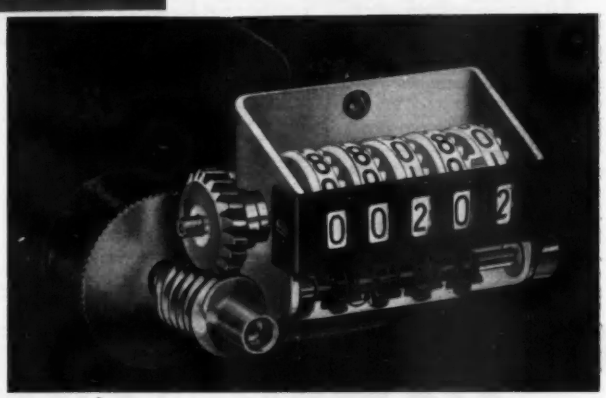

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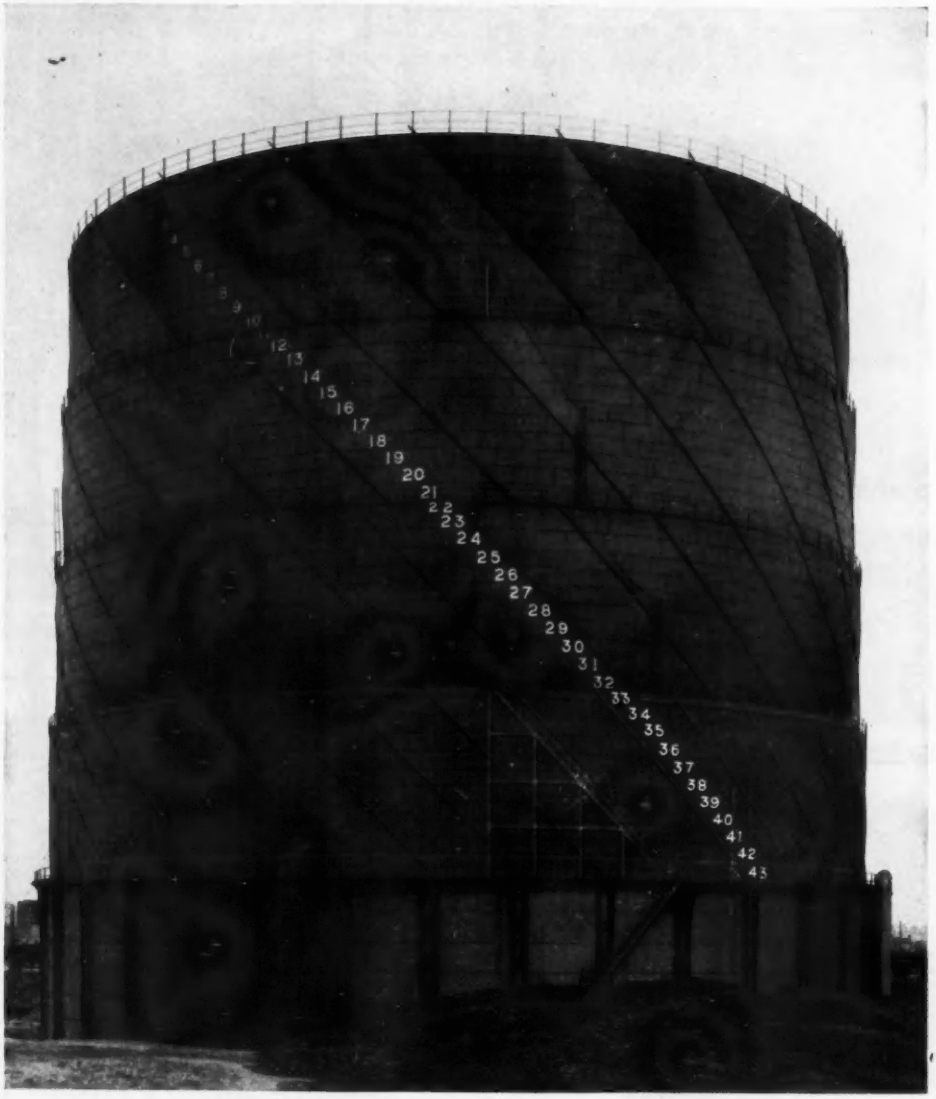

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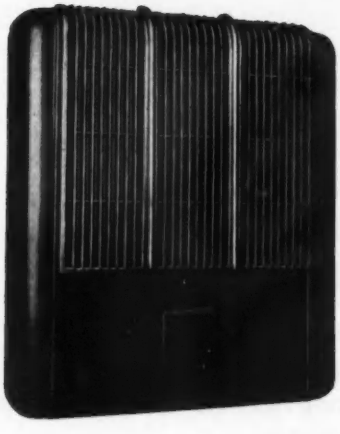

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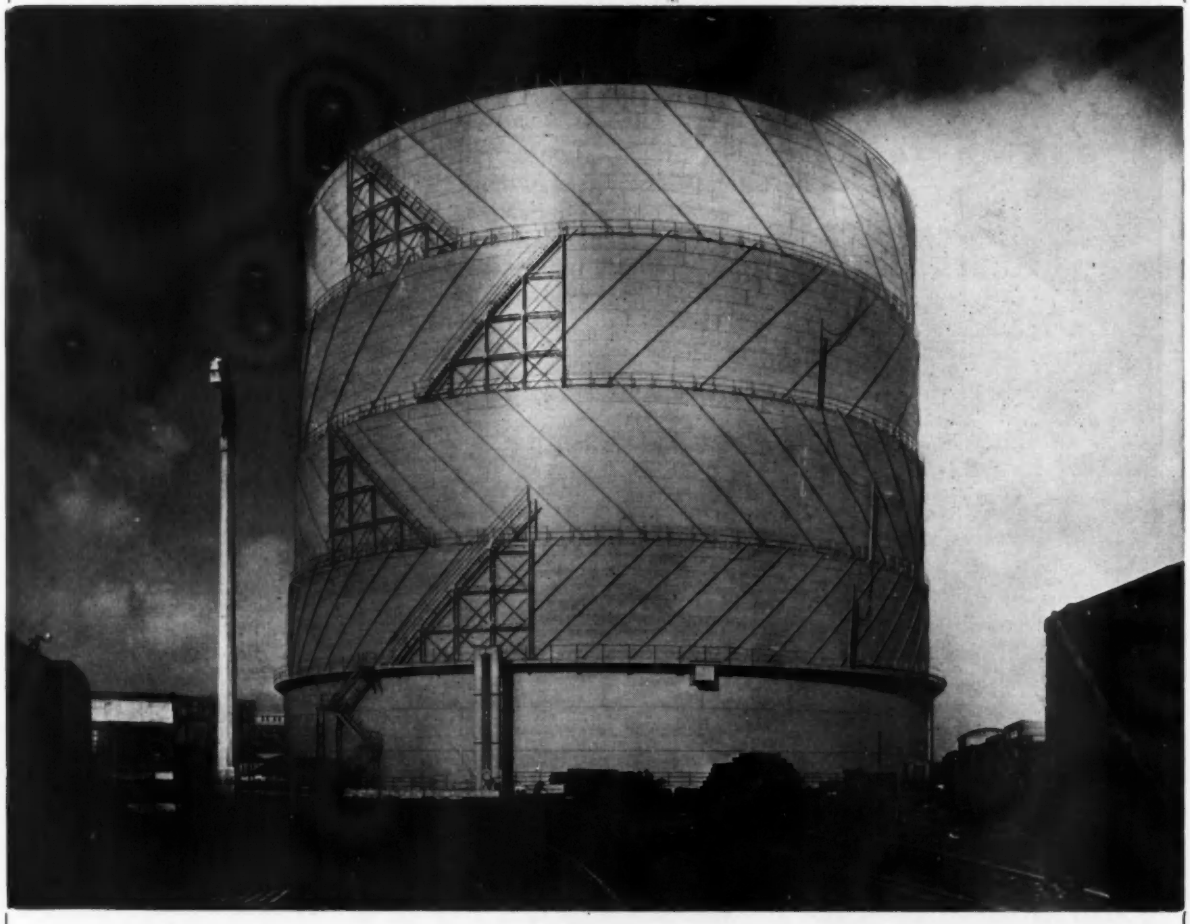

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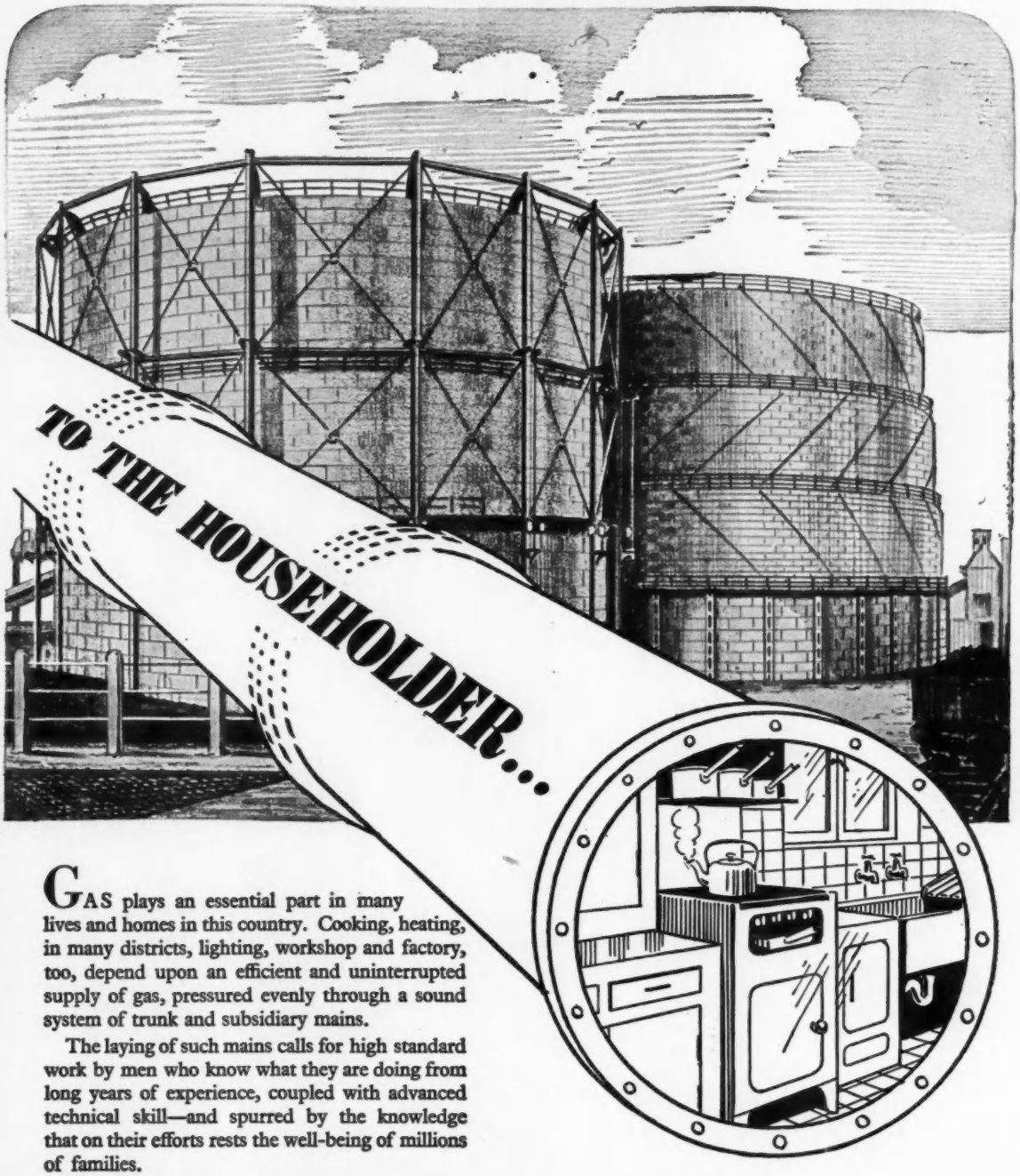

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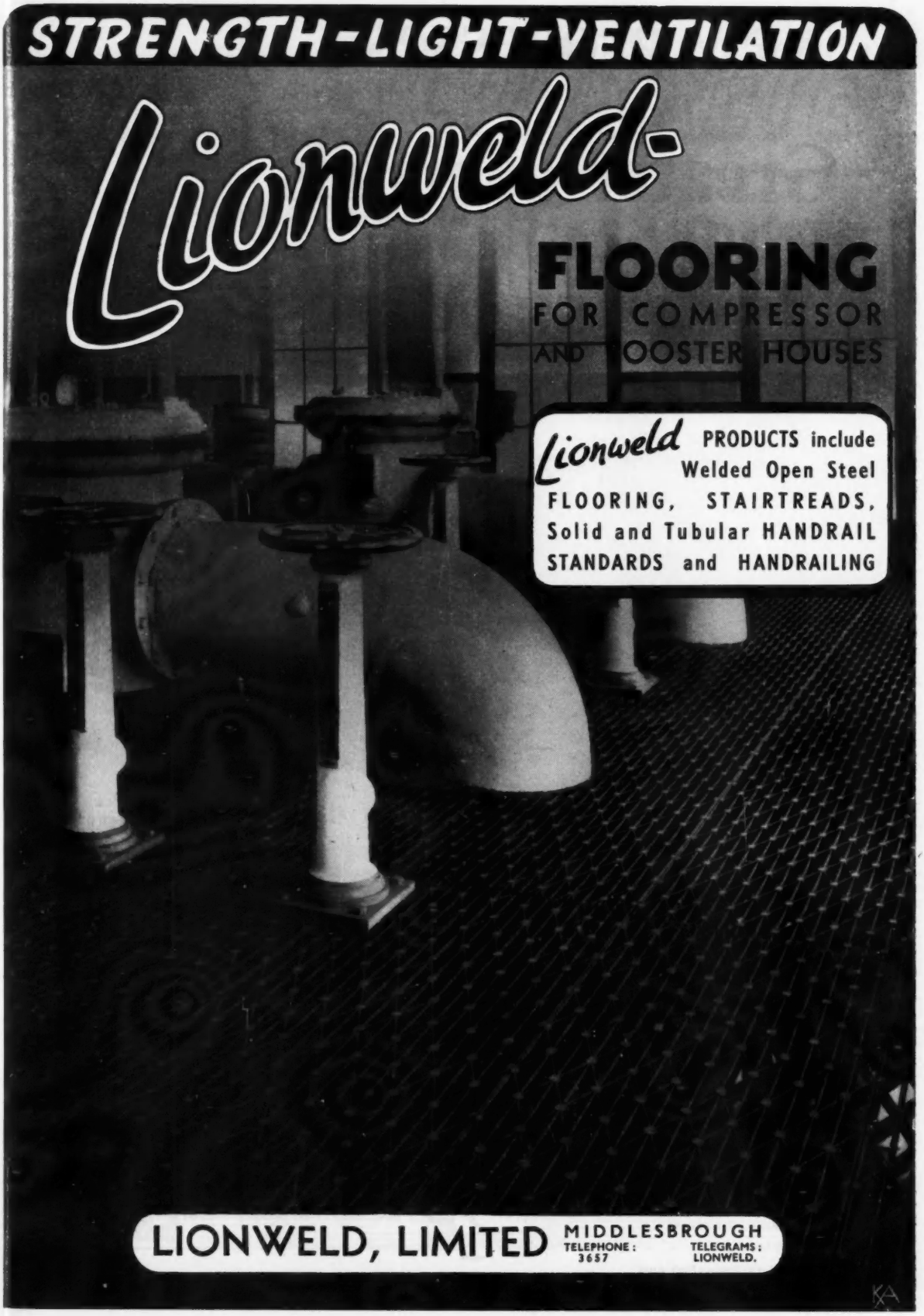
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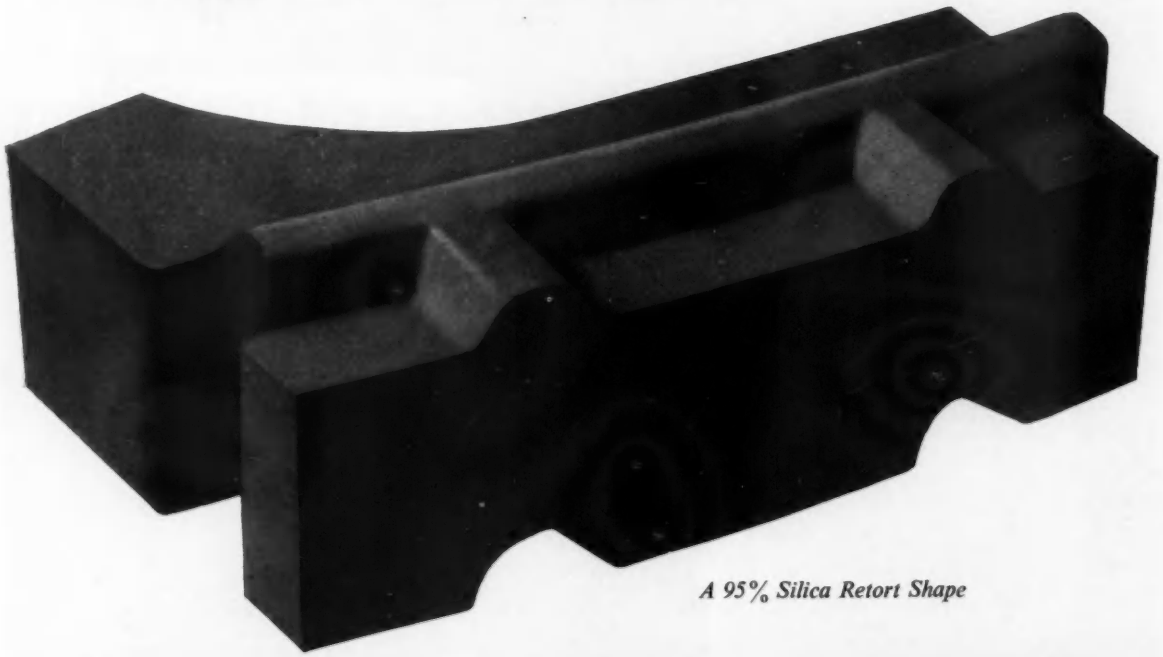

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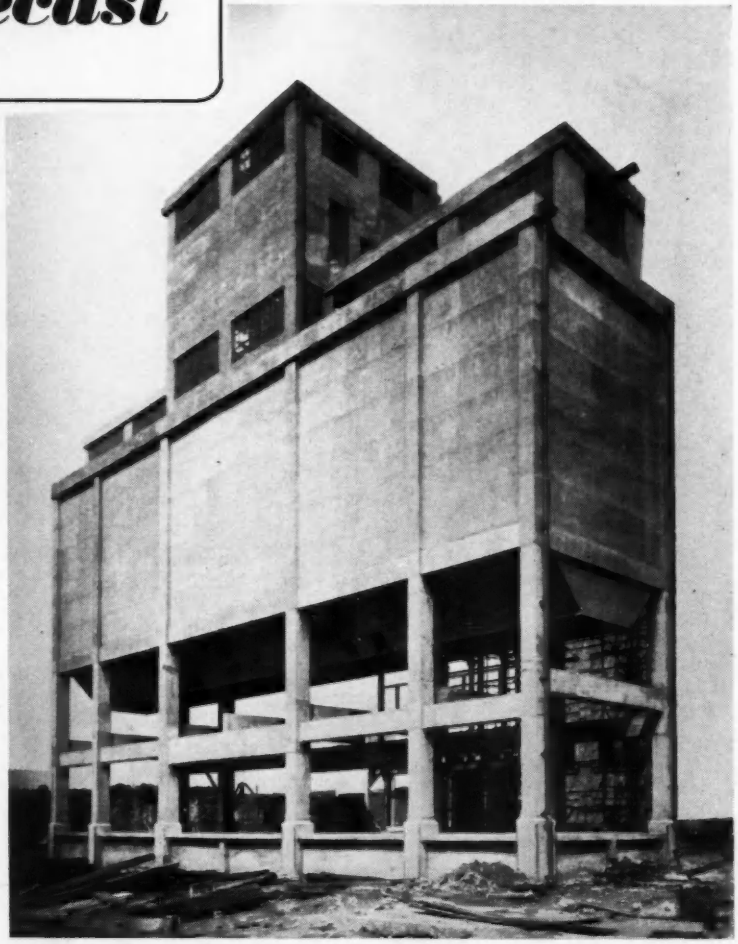

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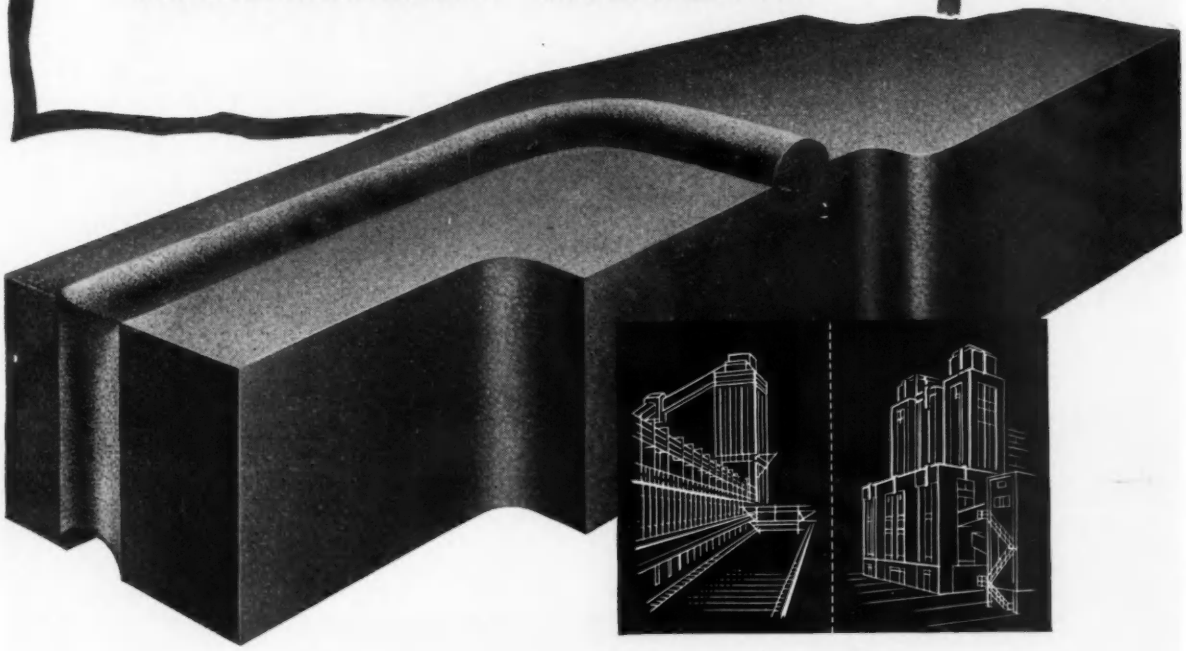

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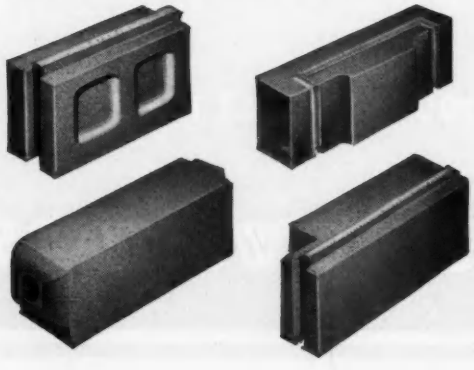

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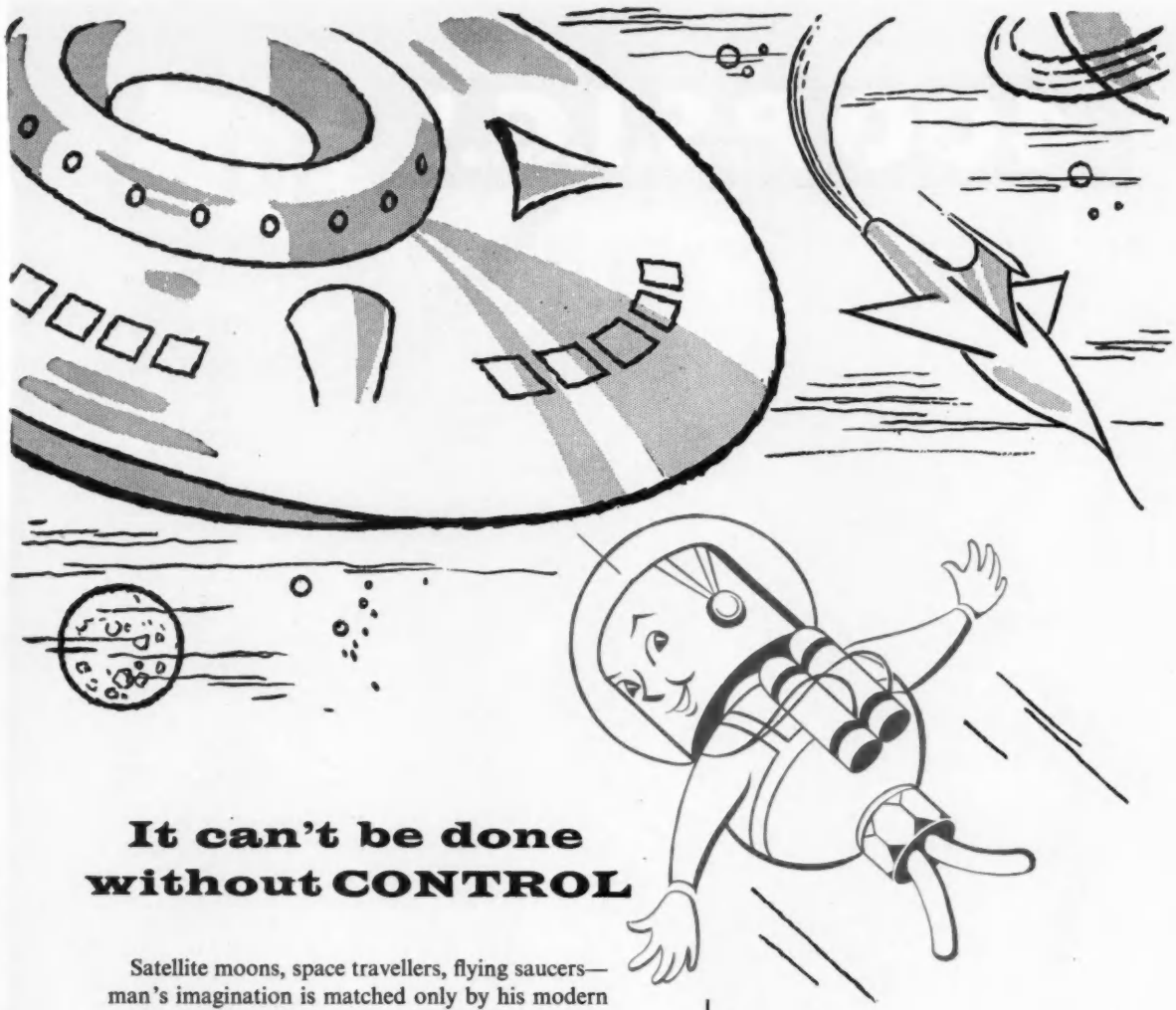

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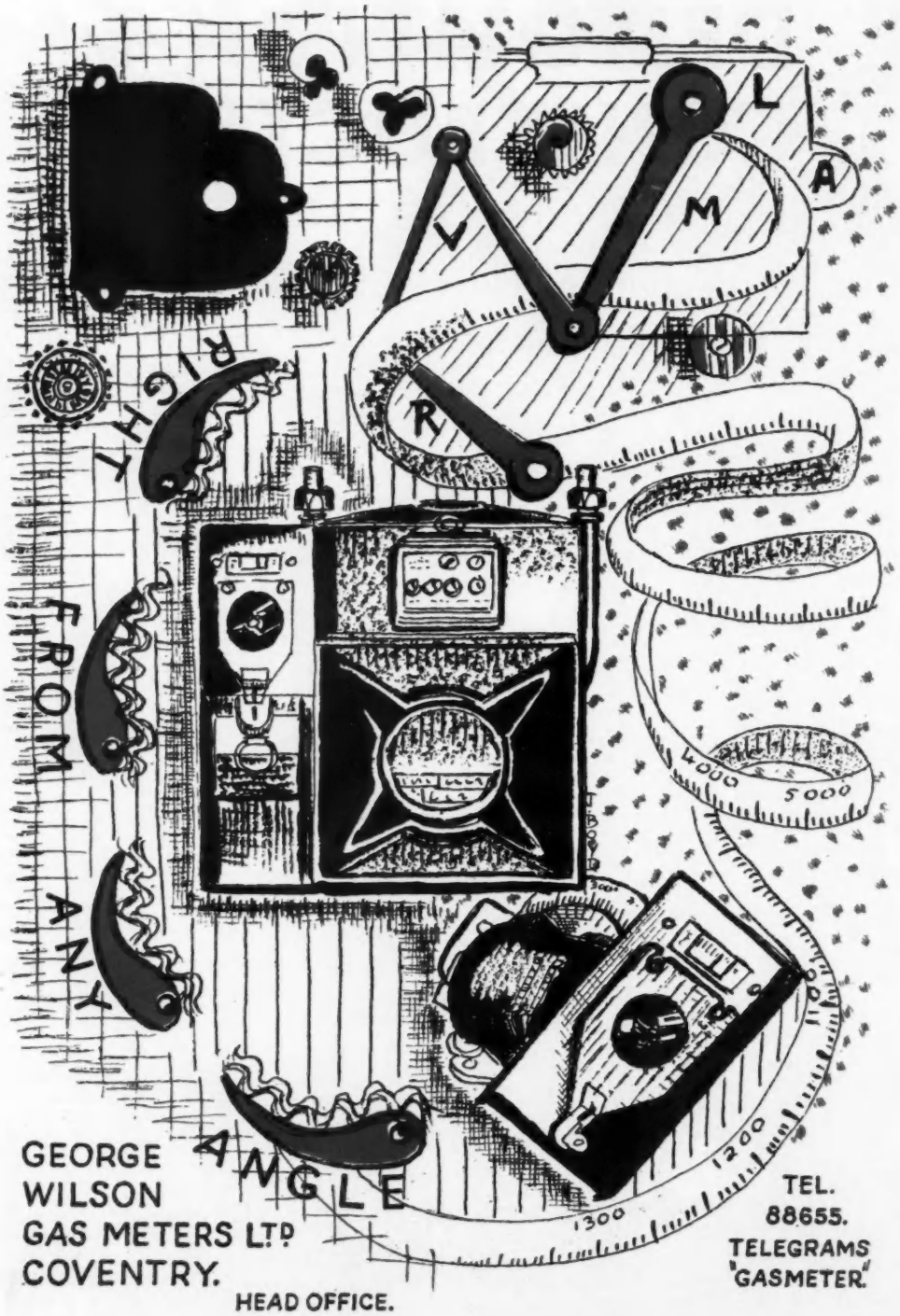

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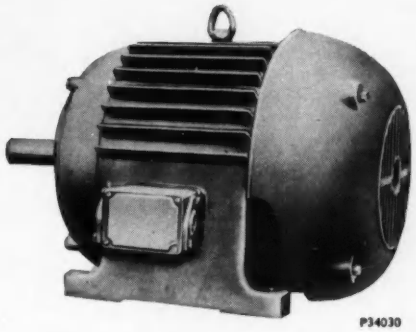

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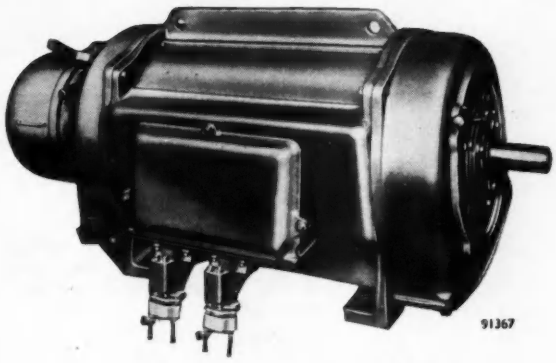
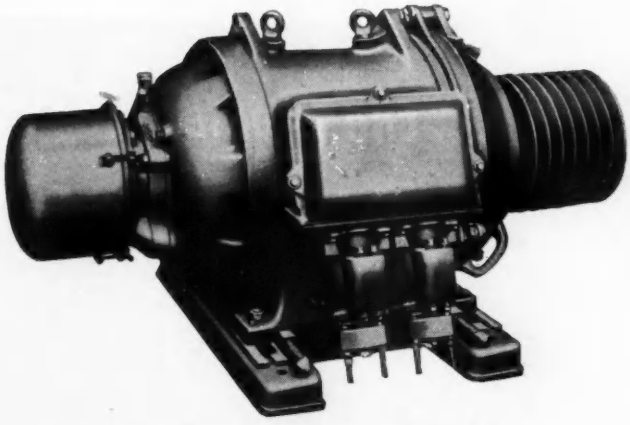


100 h.p. and above type HRW high speed (2,960 rpm) drip-proof slipring motor.



100 h.p. and above type RW totally enclosed fan cooled slipring motor.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER 17

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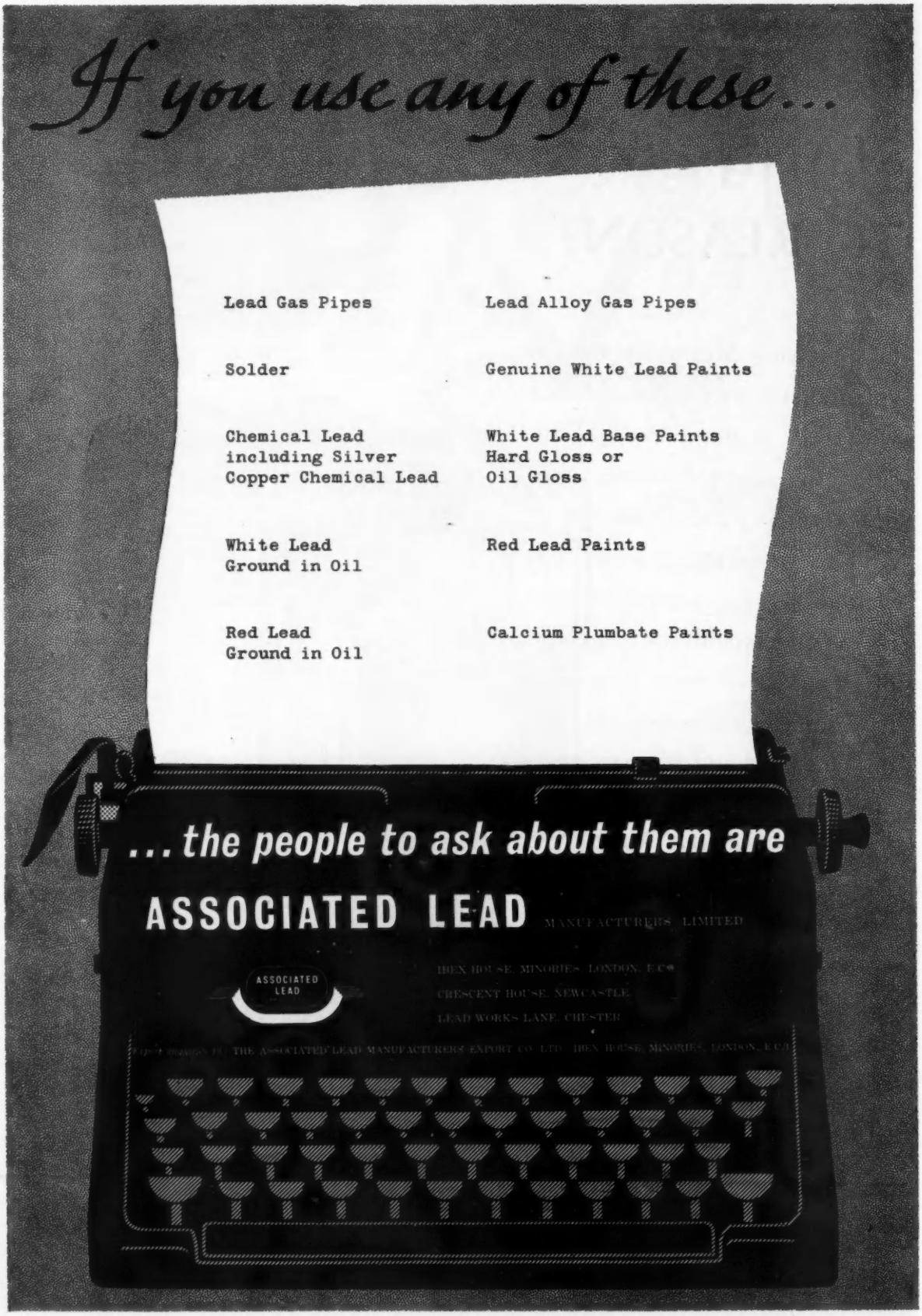
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Lead Alloy Gas Pipes
Solder
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The Figure 103

HIGH PRESSURE GOVERNOR

This governor may be arranged for gas flow in any direction, either horizontal or vertical, and it is suitable for inlet pressures up to 150 lbs. per square inch, with the outlet pressure in accordance with customers' requirements. Weight loading or spring loading may be employed according to pressure conditions.

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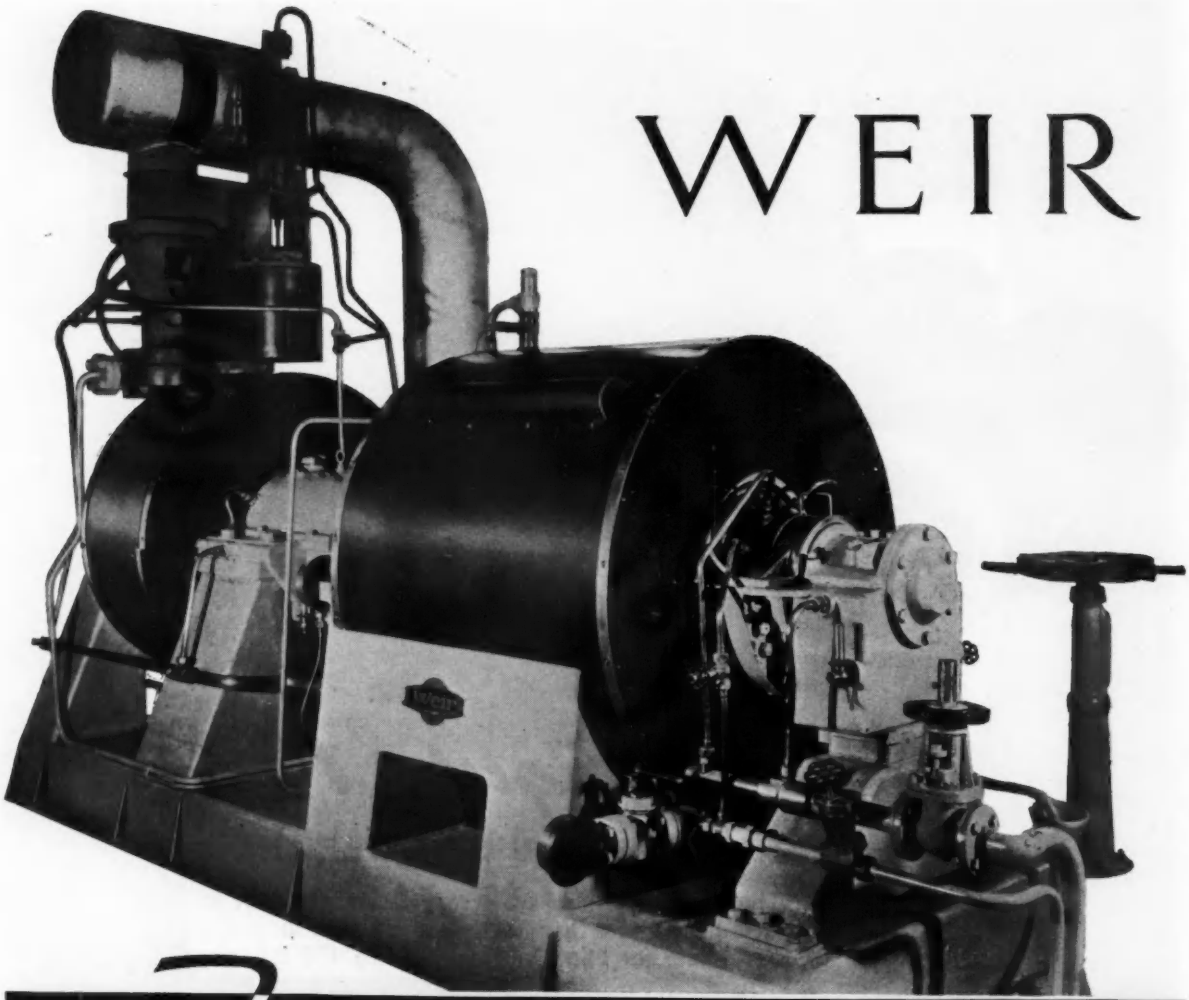

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FEED HEATERS
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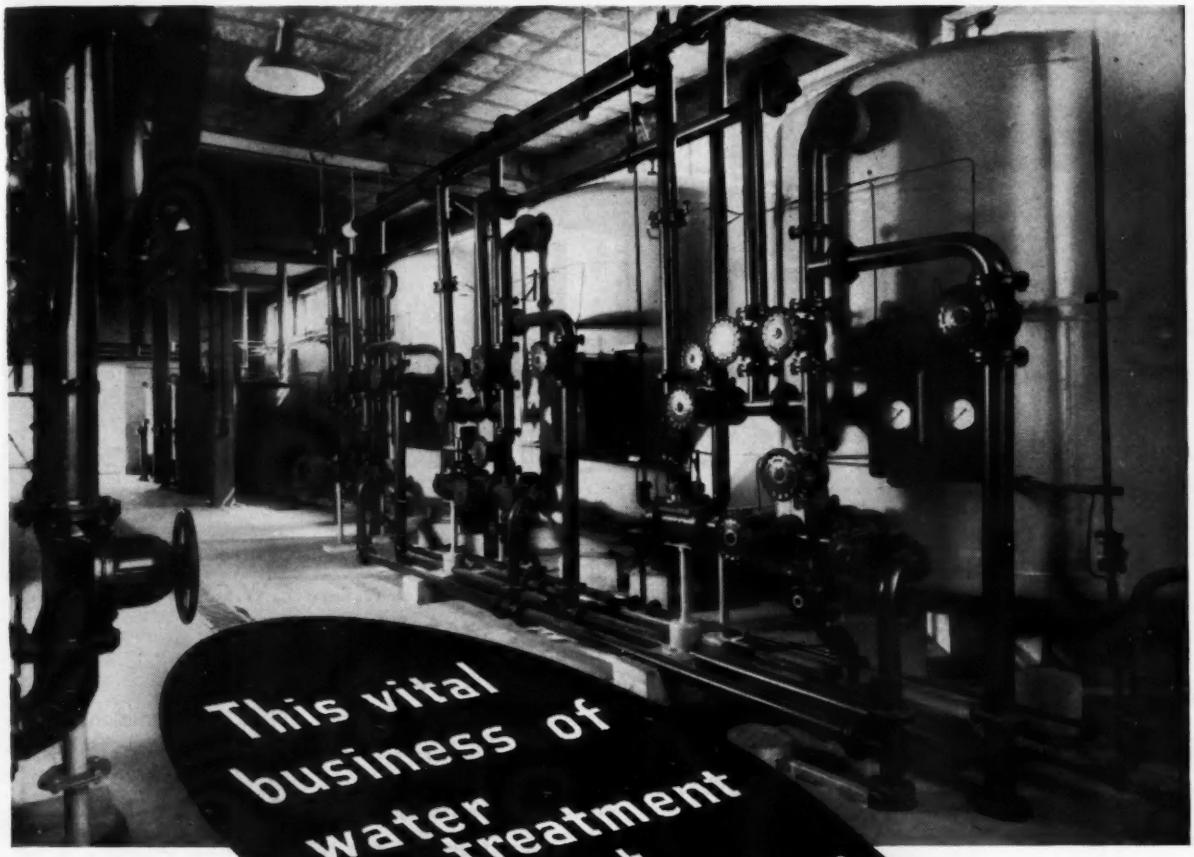
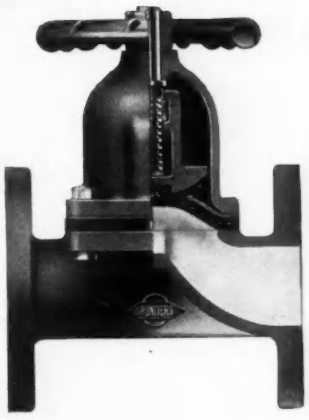


This vital business of water treatment at C.E.A. Power Stations

Photographs by courtesy of Central Electricity Authority and Messrs. John Thompson-Kennicott Ltd.

To soften and clarify River Trent water at Drakelow Power Station a Kennicott Precipitation-Stabilisation and Ion Exchange Plant is installed. This illustration shows the stabilisation section of the plant—it is equipped with Saunders Diaphragm Valves for controlling the pre-lime treated water inlet, wash and rinse water, acid regeneration and stabilised water leaving the units.

Saunders Diaphragm Valves sizes 2 in., 4 in. and 6 in. are employed and their sureness of closure and ease of maintenance ensure satisfactory operation and service. The sectional view alongside emphasises the value of the isolated mechanism for prolonging working life.



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Saunders Technical Handbook explains the many applications

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Skip Hoists, Elevators, Conveyors, Bunkers, & Structural Steelwork.

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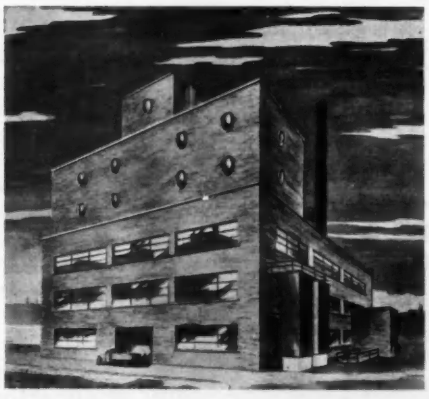
Process Controllers, Power Operated Valves, Switchgear & Instrumentation.

Two 1,000,000 cubic feet per day Oil Carburetted TULLY Complete Gasification Plants completed and put into operation at Wallasey for the N.W.G.B.



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Rope Speeds
45 to 160 ft. per min.
For A.C.
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Variable speed units employing dual motors can be supplied against specific enquiries.
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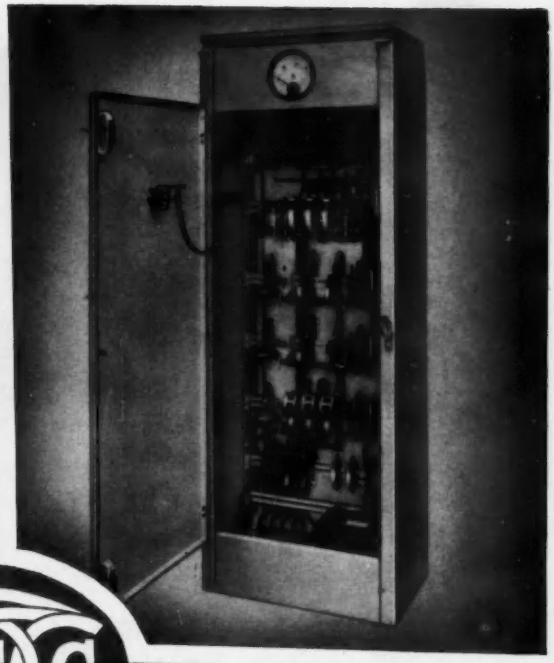
Telephone: EALing 6262 (5 lines) *And at BRIXTON, S.W.2.*



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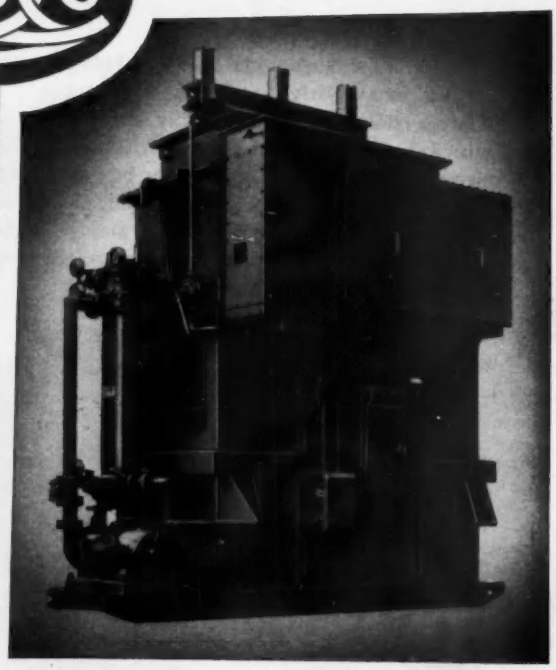

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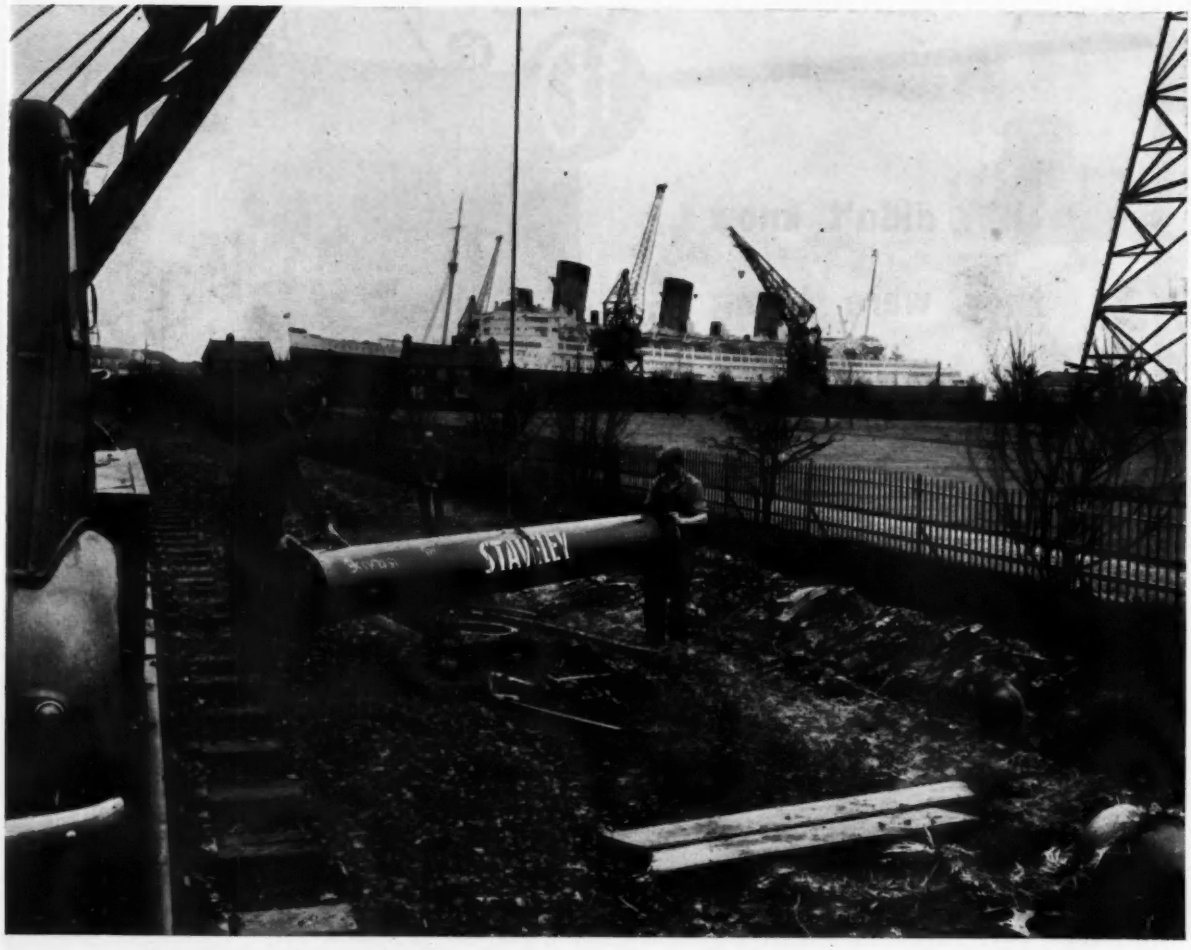


Photograph by permission of the Southern Gas Board.

15″ diameter Staveley Sand Spun pipes with Bolt Type Flexible Joints forming part of the main to carry refinery gases from Fawley to Southampton.

The photograph shows work in progress near Southampton Docks where the "Queen Mary" can be seen in the George V. Graving Dock.

STAVELEY

SAND & METAL SPUN PIPES

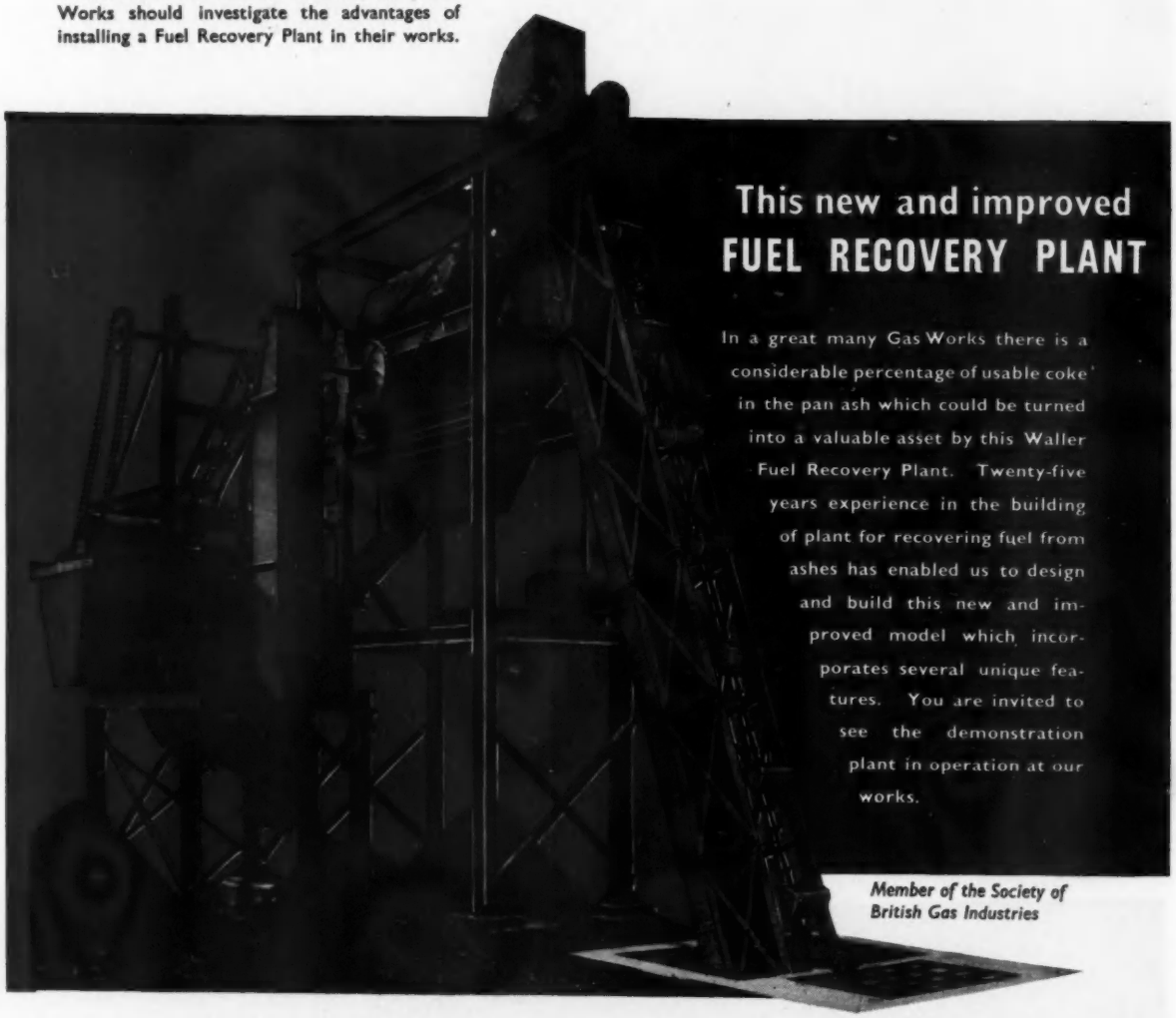
(with run-lead or flexible joints)

for GAS MAINS

THE STAVELEY IRON & CHEMICAL CO., LTD. Nr. CHESTERFIELD

THEY didn't know they were being extravagant

But today the cold wind of economic necessity demands that every last ounce of solid fuel should be used to its best advantage—even the ashes! Therefore, in the national interest, every Gas Works should investigate the advantages of installing a Fuel Recovery Plant in their works.



This new and improved FUEL RECOVERY PLANT

In a great many Gas Works there is a considerable percentage of usable coke in the pan ash which could be turned into a valuable asset by this Waller Fuel Recovery Plant. Twenty-five years experience in the building of plant for recovering fuel from ashes has enabled us to design and build this new and improved model which incorporates several unique features. You are invited to see the demonstration plant in operation at our works.

Member of the Society of British Gas Industries

GEORGE WALLER & SON LTD

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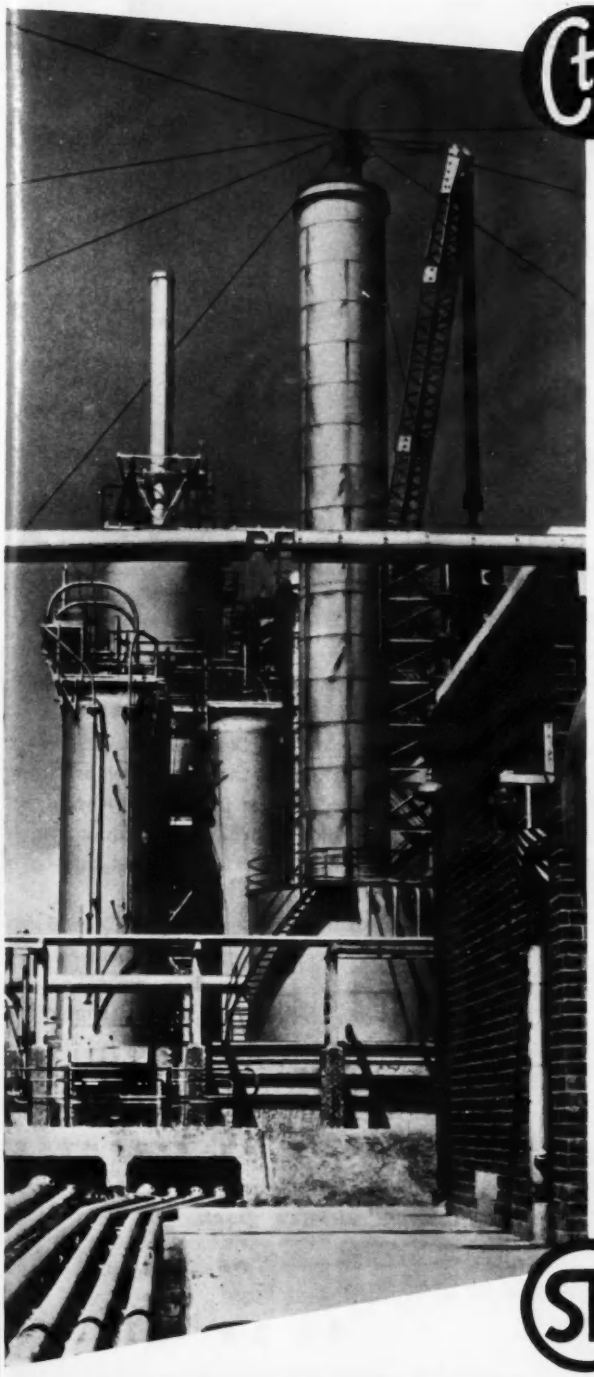

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Superior plant is the Potent Agent in achieving economical production.

GAS INSTALLATIONS require pipes and fittings that will give efficient service allied to well planned layout.

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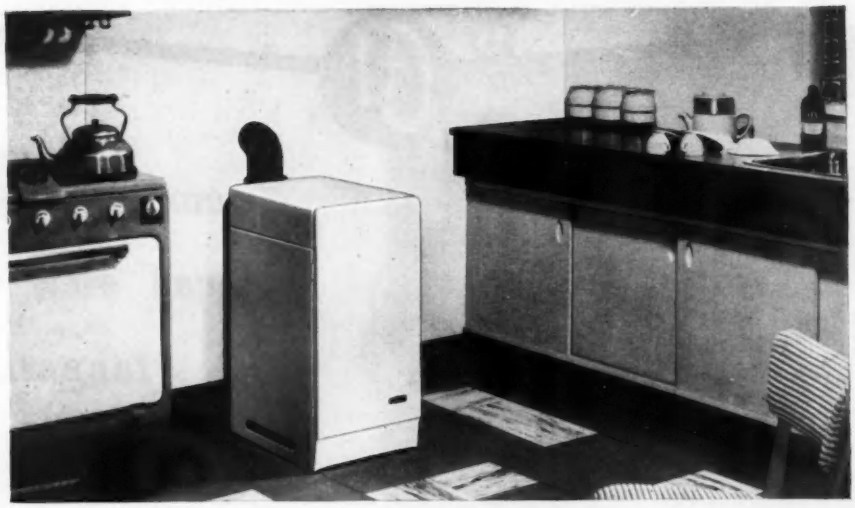
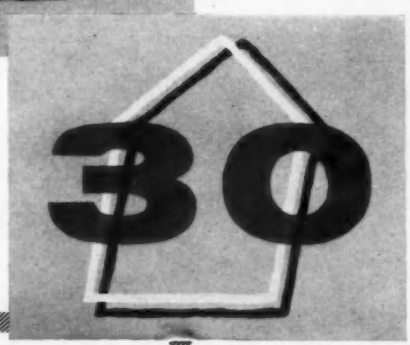


A year's full hot water supply in a three-bedroomed house for £18.12s.7d.

That is the actual cost (with gas at 1/4½d. a therm) of the operation of an earlier 'Potterton' 25,000 B.t.u/hr. model in the period October 1955—October 1956. The boiler is fitted with a clock control having a four tappet dial to provide an 'off' period during the day as well as during the night. The boiler serves a 40 gallon cylinder providing hot water for a bath, four basins, sink and washing machine. Consumption is approximately 300 gallons a week and the water is raised through a temperature of 80°F.

On these figures, the small gas-fired boiler is a really practical proposition for many householders. Clearly there is a ready market for the latest 'Diplomat' which combines with such performance and attractive design facilities for speedy, simple and inexpensive maintenance.



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A MODEL OF SELF-CONTROL

Available in white · cream scarlet and viridian green

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	Height	Width	Depth
DIPLOMAT 30	32⅛"	15"	27"
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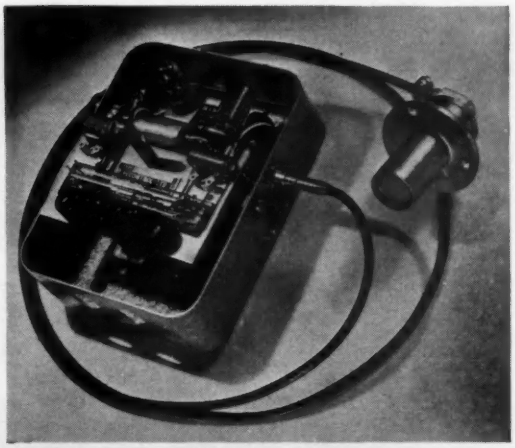
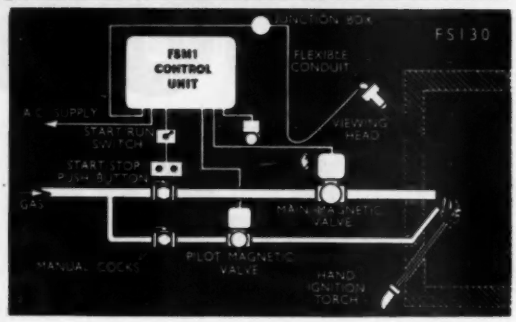
A range of models is available for all burners from the small domestic type to the largest units as used in power station or blast furnace work





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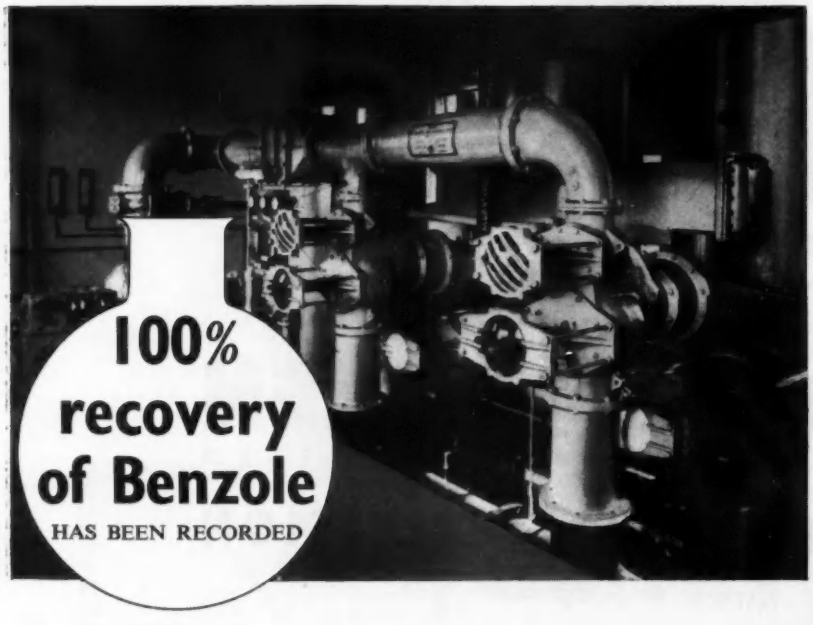

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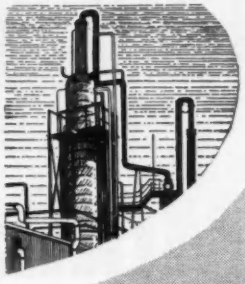

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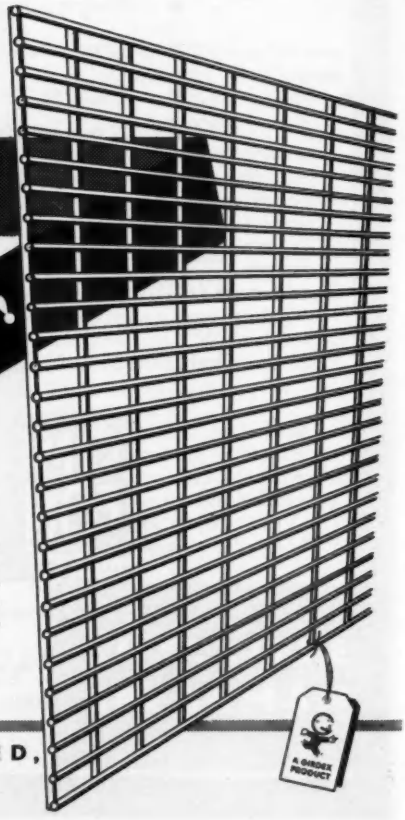

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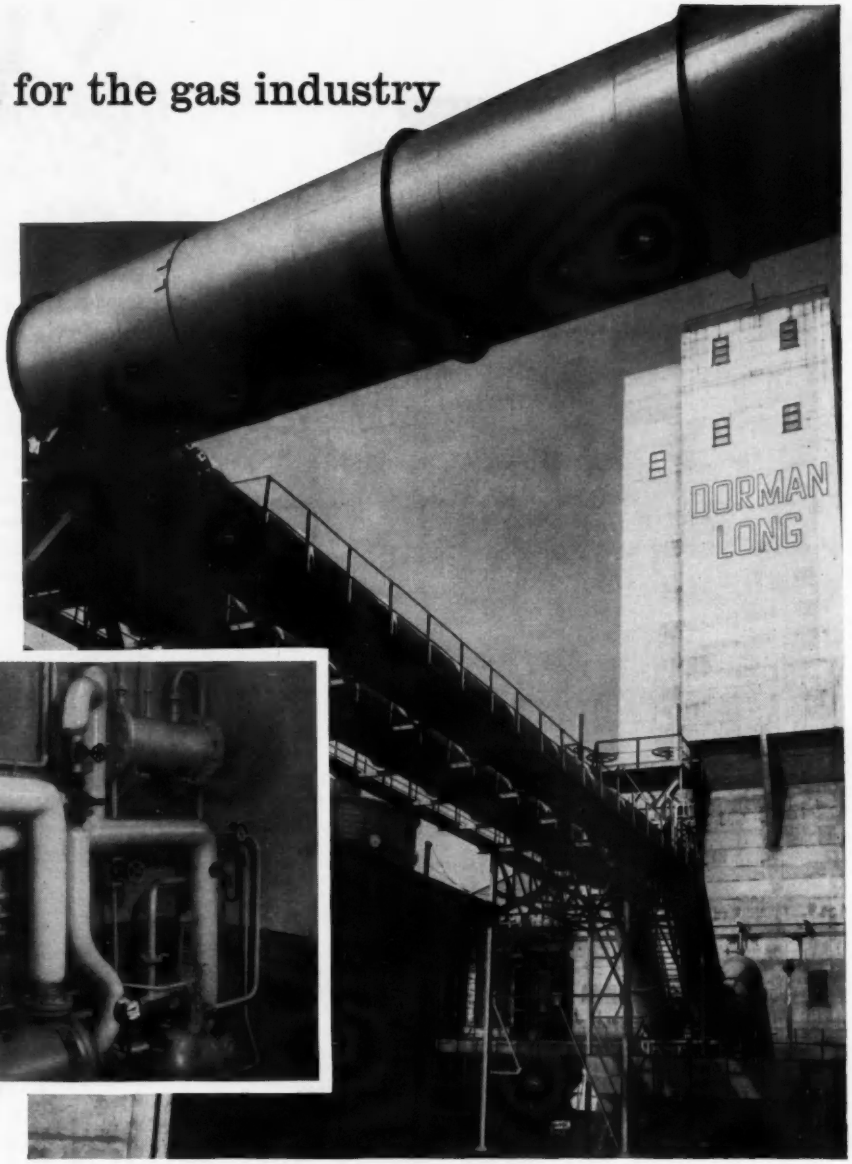
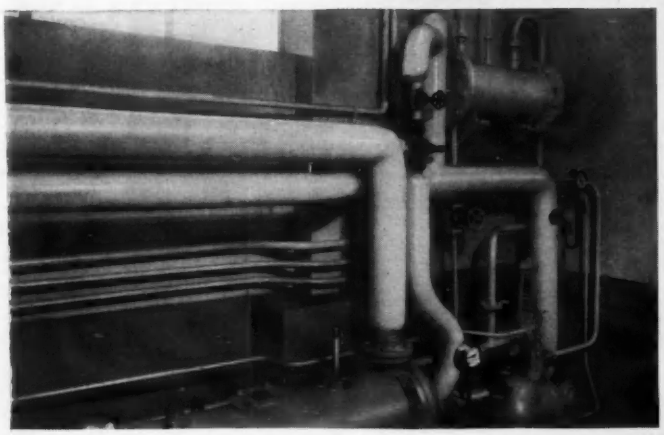


This photograph shows a Welded Steel Blast Furnace Gas Main to Coke Ovens being welded at the Dorman Long factory by the United Kingdom Construction & Engineering Co. Ltd. for the main contractors, Simon Carves Limited.



The Calorifier Room, showing Heat Exchanger, Condensate Receiver, Lift Trap and Pressure Relief Valve, with Interconnecting Pipework, installed for Dorman Long by the United Kingdom Construction & Engineering Co. Ltd., to the order of Simon-Carves Ltd.

These photographs show just one example of the many large-scale projects entrusted to the capable hands of the United Kingdom Construction & Engineering Co. Ltd., who have years of experience in this sphere. Their technical experts are at your service to submit tenders to your specifications for projects in any part of the country.

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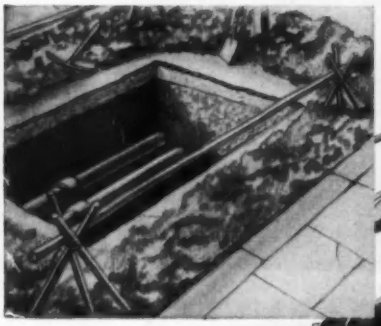
The "Visco" 'Reciprojet' Self-Cleaning Air Filters shown are two of five we have installed at the Albion Works of The Briton Ferry Steel Co. Ltd. These filters have a total capacity of 118,000 cu. ft. air per minute and form part of the ventilating system of the Power House and electrical equipment.

Recent installations include the equipment we have installed at Silverwood and Cadeby Collieries. Here "Visco" Reciprojet Air Filters clean the air for the motor generator sets in the winding houses.

Write for "Visco Self-Cleaning Air Filters" List No. 562

THE VISCO ENGINEERING CO. LTD., STAFFORD RD., CROYDON **Phone Croydon 4181**



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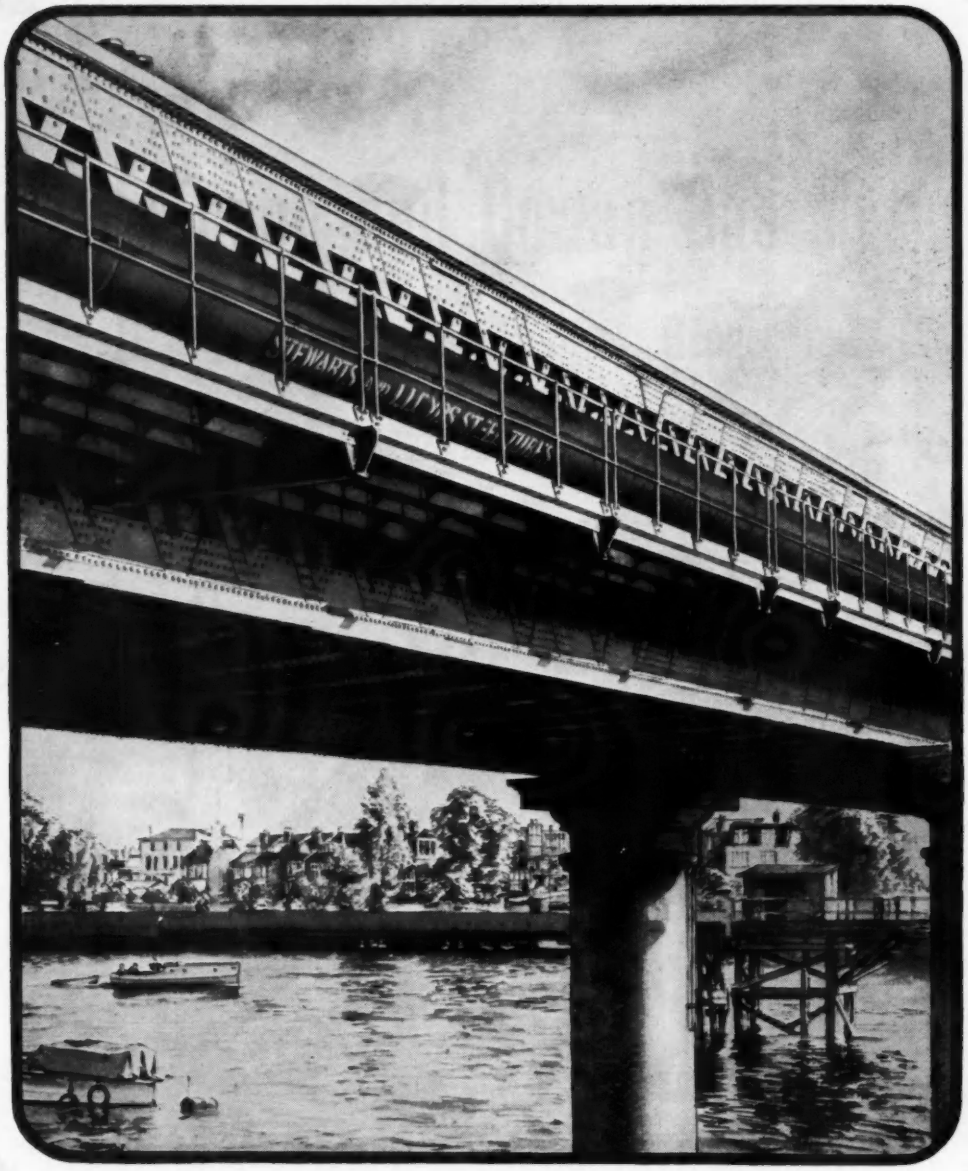
Atkins, Robertson & Whiteford Ltd., Industrial Estate, Thornliebank, Glasgow
MacKellan Automation Ltd., 122 Seymour Grove, Old Trafford, Manchester 16.



THE STEEL TUBE AGE

Steel gas main, 36¾ in. outside diameter,
with sleeve joints welded externally (see section below),
installed by the North Thames Gas Board
across the River Thames at Putney.

STEWARTS AND LLOYDS LIMITED

GLASGOW · BIRMINGHAM · LONDON

The largest manufacturers S&L *of steel tubes in Europe*

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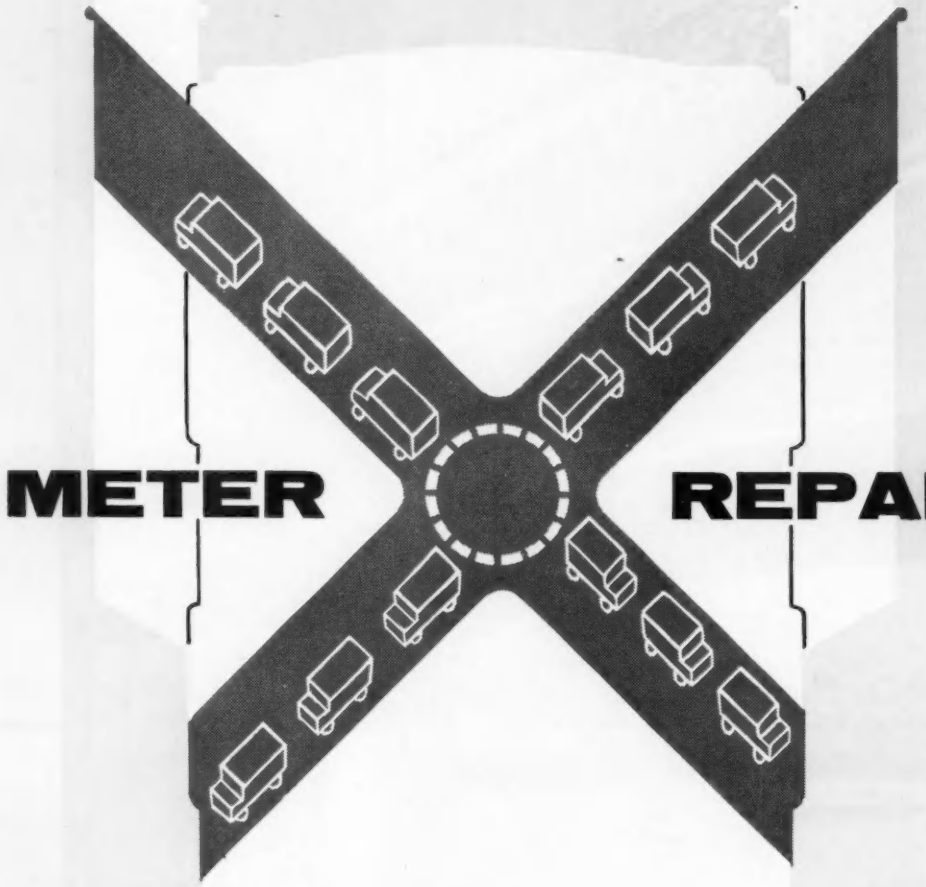


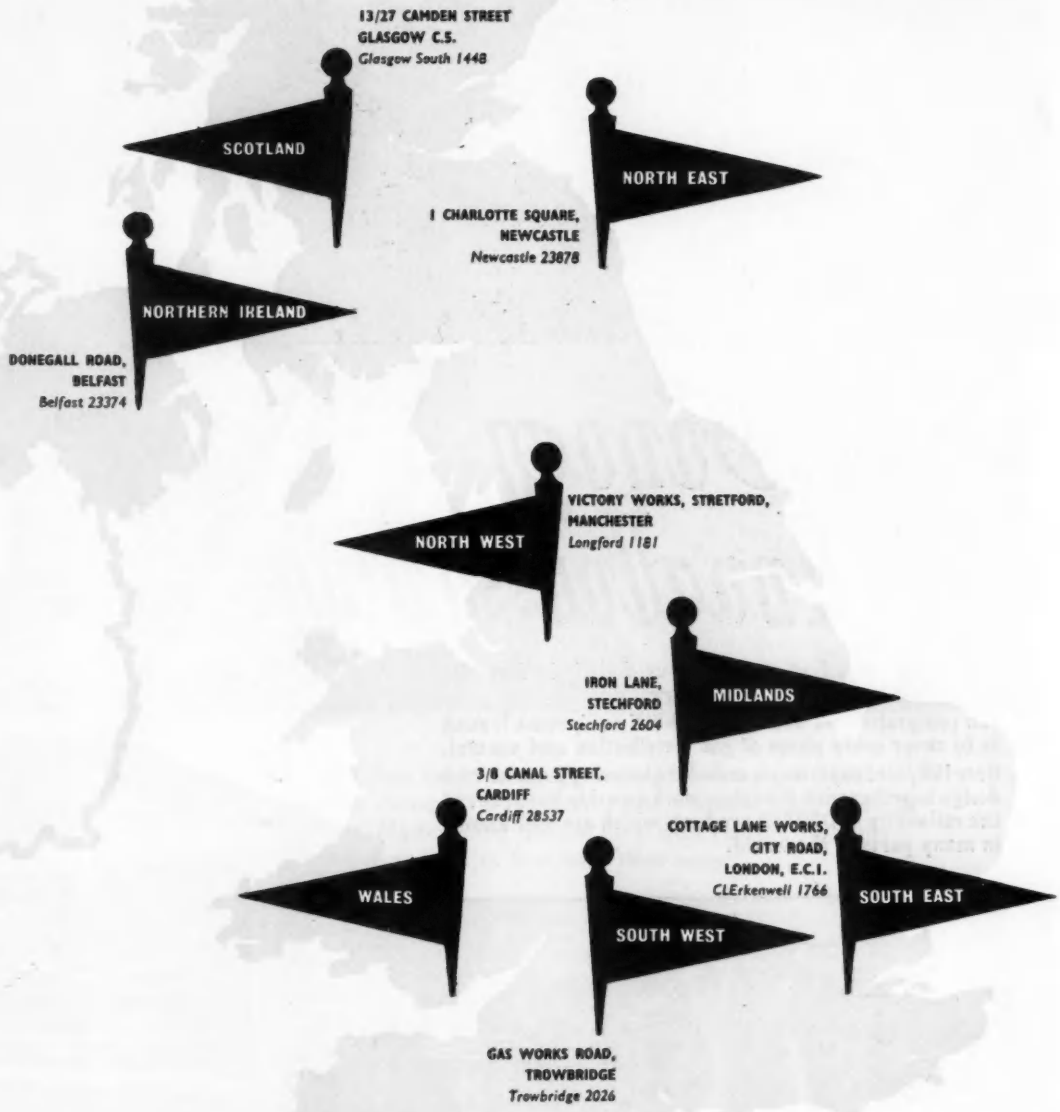
Parkinson and Cowan Gas Meters are organised to deal with meter repairs on a quality basis.

They have their own transport operating back to eight Depots in the United Kingdom ensuring prompt return of all repairs entrusted to their care. Five generations of experience are behind this service.

PARKINSON AND C

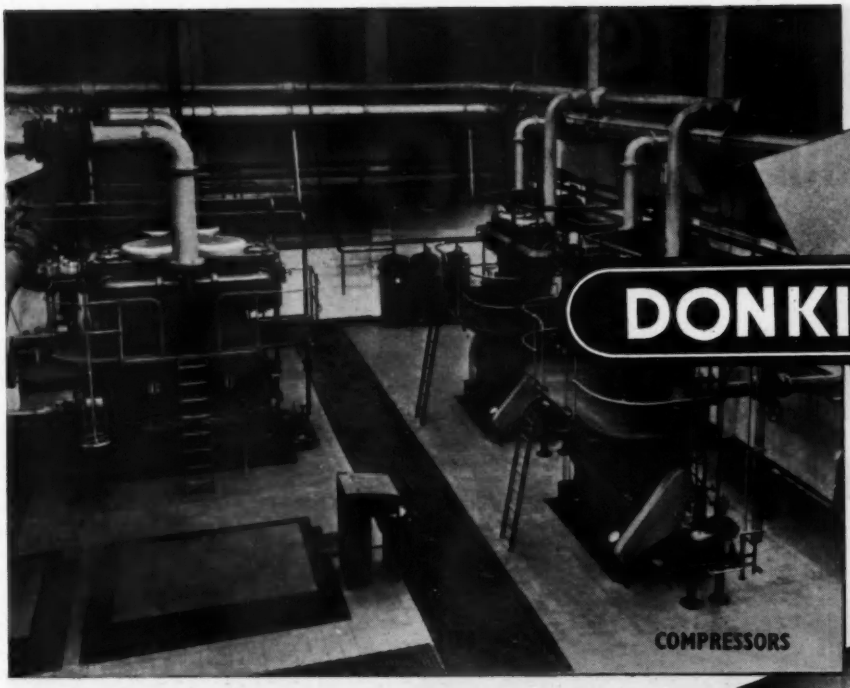
Parkinson and Cowan Gas Meters

Geographical Coverage



COWAN GAS METERS

A DIVISION OF PARKINSON AND COWAN LIMITED

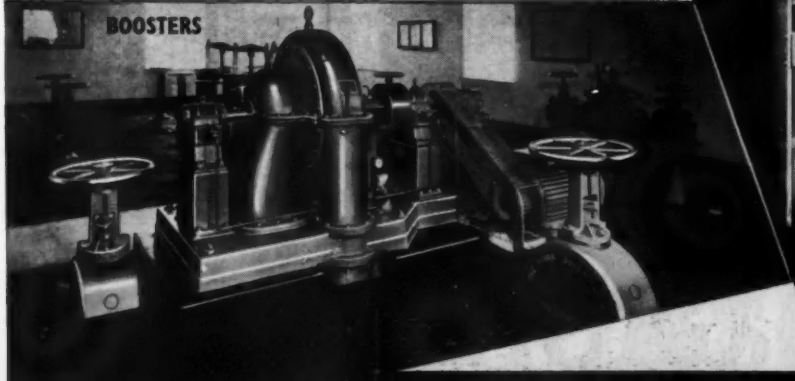


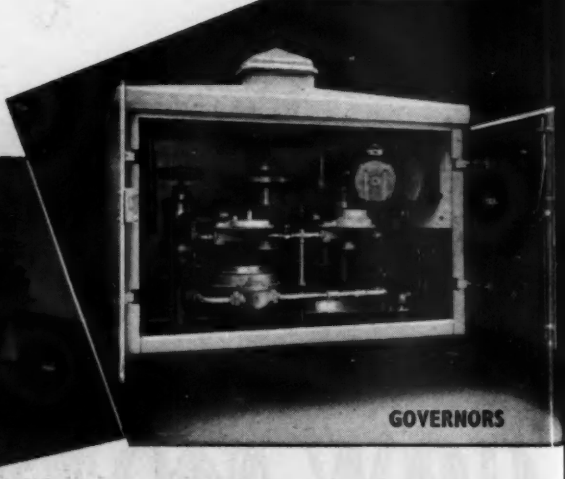
Serving Industry

Millions of cubic feet of gas are used daily in factories and homes throughout the country.

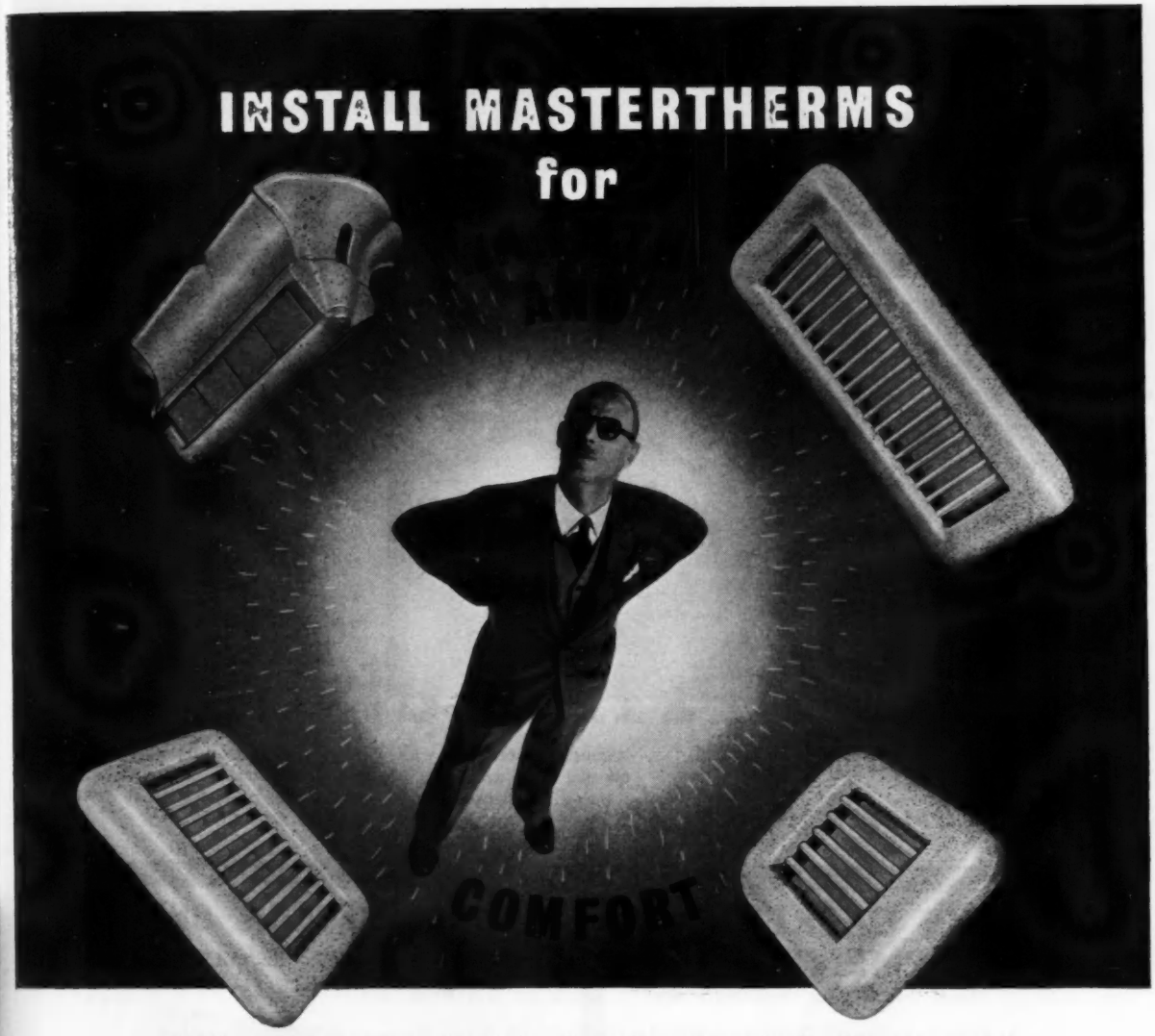
The comprehensive nature of DONKIN equipment is such as to cover every phase of gas distribution and control.

Over 150 years experience, sound engineering practice and design together with first class workmanship have proved the reliability of DONKIN products which are well known in many parts of the world.





THE BRYAN DONKIN Co. Ltd. CHESTERFIELD



The Mastertherm range consists of four finely designed overhead radiant gas heaters, each of which effects considerable saving in both money and valuable floor space. Costing little to install or operate, Mastertherm heaters give high radiant efficiency and ensure even distribution of heat over floor area.

As wall or suspension fittings they can be tilted at any angle from 30 to 75 degrees, distributing radiant heat —the healthiest known—downwards and outwards over an exceptionally wide area.
Although particularly suitable for lofty buildings where the maximum tilt is used, Mastertherms are equally efficient in buildings or rooms with lower ceiling heights—where minimum tilt is of course used. Mastertherm heaters are encased in attractive, vitreous enamel stone-coloured surrounds which blend with any colour scheme. Designed for use on low pressure town gas or liquid petroleum gases.

MASTERTHERM No. 1.
Heats up to 125-150 sq. ft. of space.

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Heats up to 250-300 sq. ft. of space.

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Heats up to 375-450 sq. ft. of space.

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A double sided heater for small offices, corridors, cubicles—wherever a larger heater is unsuitable. (Heats 150 sq. ft.)

Send for full details and illustrated literature on the 'Mastertherm' range to:

RADIANT-HEATING LTD

Burning gas without flame!

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C & T LTD STACKING, DEBREEZING AND BAGGING . . .

CRONE & TAYLOR HAVE THE EQUIPMENT FOR YOUR PURPOSE

'BIG WALRUS' STACKER

Fully Mobile, Electric or Diesel

★ ***STACKS 120 TONS OF COAL PER HOUR!***

Ramps are unnecessary when feeding from normal tipping lorries, as opening in the extra wide hopper permits direct access from front at low level. Rubber sealing flaps around hopper opening and steel skirt plates on belt reduce spillage to negligible proportions.

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at Mond Gas Works, Tipton, Staffs.

Capacity 30-40 Tons per hour!

West Midlands Gas Board use a C. & T. 60 ft. Centre Super Mobile Stacker delivering coke onto a C. & T. Skid Mounted Debreezing Unit. Stacker is fitted with oversize hopper, fed direct from mobile shovel. Coke is delivered into screen hopper, and fed onto mechanically vibrated single deck screen. Oversize material is discharged into railway wagons. Fines are passed through mesh into storage hopper.

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Speed Handling · Reduce Costs!

Can bag and weigh up to 12 Tons of Coal in 34 mins.!

C. & T. Junior Bagging Unit is designed to handle 1 cwt. Coal Bags—can cope with pieces up to 8" max. size. The unit incorporates Electrically Vibrated Bagging Chutes, giving fine control over material being bagged—a foot-switch leaves the operator's hands free to hold bag.

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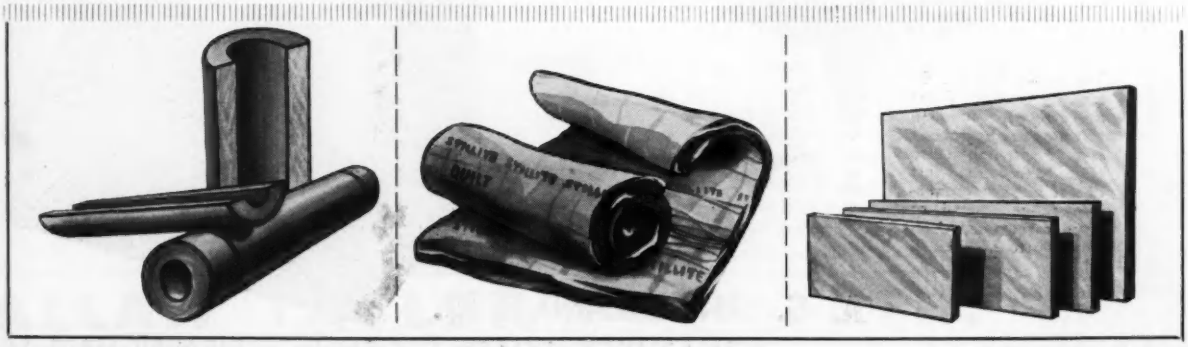
Stillite is a manufactured mineral wool which has very valuable characteristics as both a thermal and an acoustic insulator.

It is supplied in a variety of forms to meet most requirements and provides a system which will answer the majority of insulation problems.

Our technicians are always at call to co-operate with your engineers in dealing with all matters of insulation. The Stillite service covers a temperature range extending from −184° C to +815° C.



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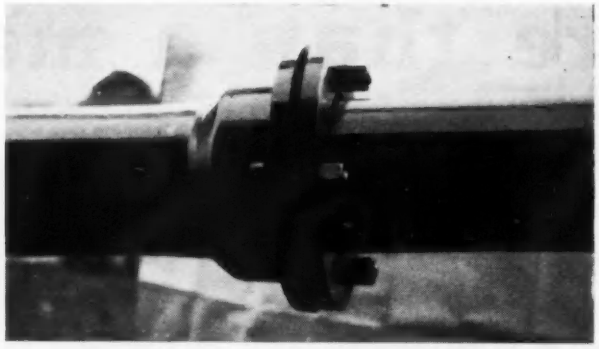

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INDUSTRIAL GAS METERS

The new 700 cu. ft. capacity meter *(illustrated right)* is supplied with prepayment attachment designed to take halfcrowns. Just one of our comprehensive range. Small or large cases; capacities from 700 to 9,000 cu.ft.

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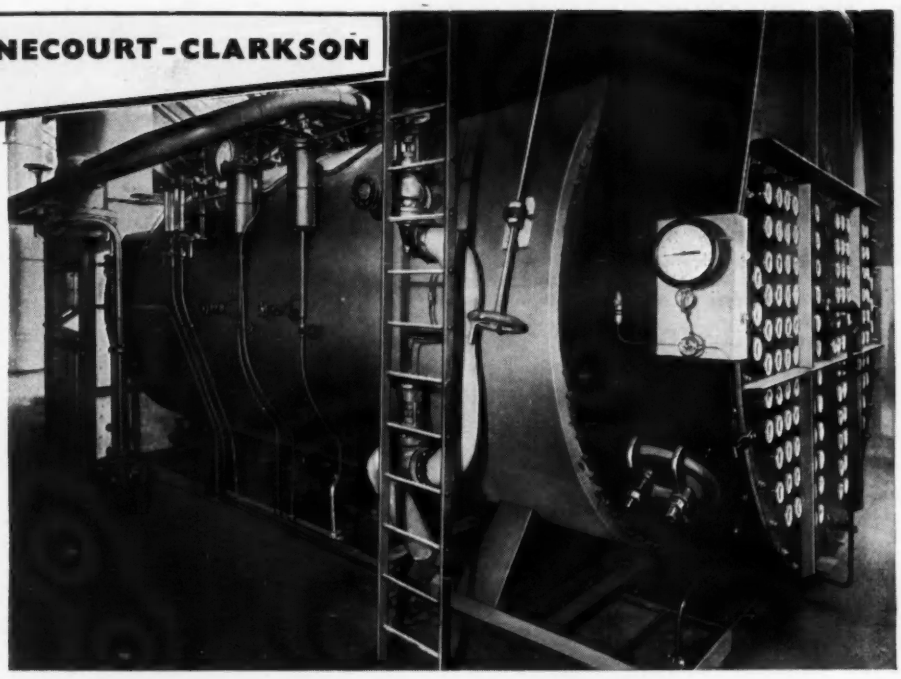

The illustration shows one of the Spencer-Bonecourt waste-heat boilers at Stoke-on-Trent Gas Works. Similar units are installed on all the Glover-West Continuous Vertical carbonising plant in this works.

LYNTON HOUSE, 7-12 TAVISTOCK SQUARE, LONDON W.C.1.

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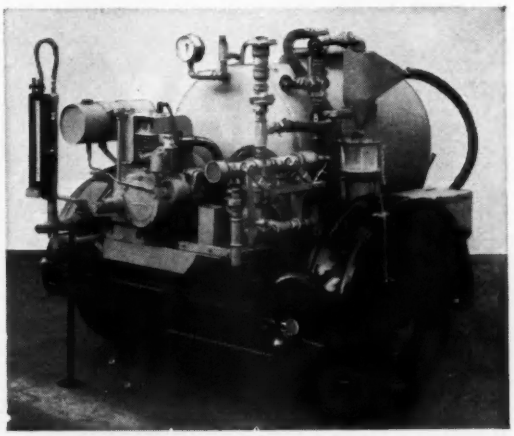
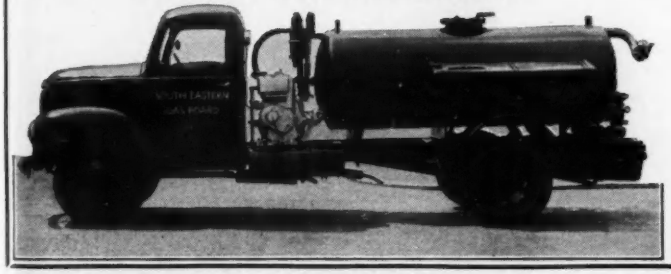
CLEANING BLOCKED SERVICE PIPES METHODS REVOLUTIONISED BY

ALLAN TAYLOR SERVICE PIPE CLEANING OUTFIT

The 75 gallon Allan Taylor pressure/vacuum service cleaning equipment complete with exhauster which can be used for vacuum or pressure. Normally used as a trailer unit and towed by a 10 cwt. van. Visible in the photograph (*right*) are the cyclone and test bar. This additional equipment enables the operator to make pressure tests before and after cleaning the service pipe, the test taps passing 50 cu. ft. or 100 cu. ft. as required. By using the Cyclone the dust drawn from the service pipe is deposited in the sight glass for inspection and can then pass into the easily removable container below. The arrangement further enables the operator at the machine to determine whether or not there has been any success with a cleaning operation. The extractor also prevents the greater part of the rust dust from entering the 75 gallon cylinder.



SYPHON EMPTYING OUTFIT



The Vacuum Syphon Emptying Outfit illustrated is mounted on a 4 ton **Thames** Chassis. A 600 gallon galvanised tank is fitted. A rotary type exhauster is driven by a 4 b.h.p. four-stroke air cooled engine, mounted on a sub-frame behind the cab. The tank is fitted with a flame-proof vent and the outfit can be used for high or low pressure syphon emptying. A large manhole at the rear allows the tank to be cleaned easily. A sight glass is fitted to enable the operator to know when the Syphon is emptied. Twenty-five feet of 1½ in. suction hose is supplied with the outfit. The outfit can be used for vacuum or pressure working.

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ALL COCHRANES SPUN IRON PIPES
ARE WORKS HYDRAULICALLY PROOF
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Screwed-Gland Flexible Joint : up to 10" dia.
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NON-ATMOSPHERIC AND
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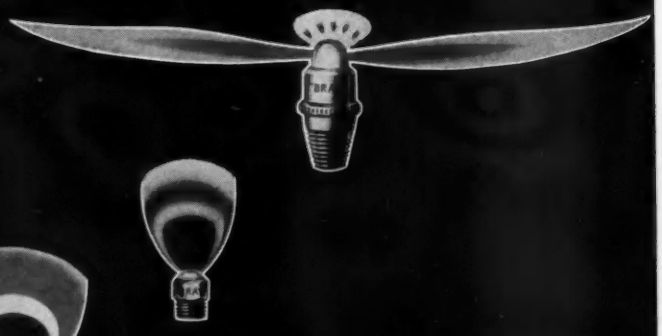

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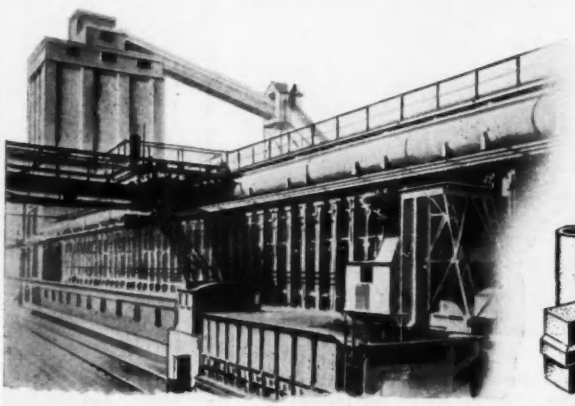
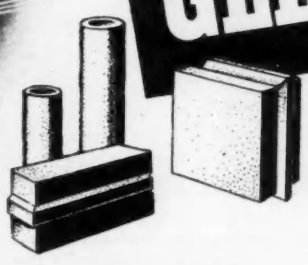
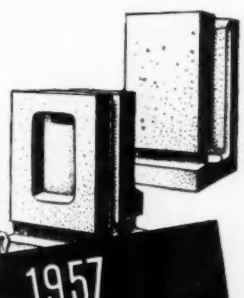
of FIREBRICKS *for the* GAS INDUSTRY







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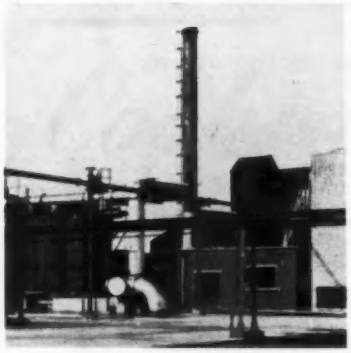

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TO ALL TYPES OF
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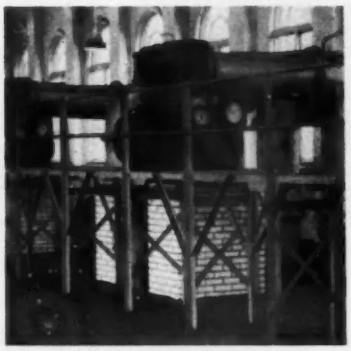

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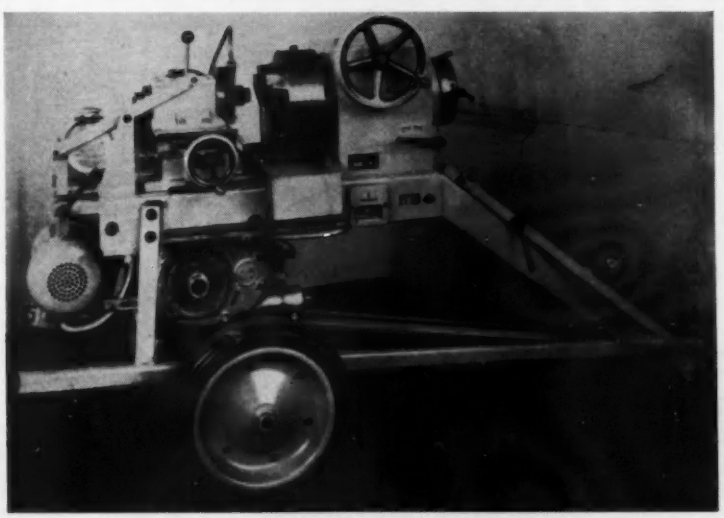

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THE "RG" MACHINE PRODUCES THREADS BY MEANS OF THE MILLING PRINCIPLE—NO DIES REQUIRED. A CIRCULAR SAW FITTED TO THE CUTTING SPINDLE ENABLES TUBING TO BE SAWN, FREE OF BURR, TO ANY REQUIRED LENGTH WITHOUT REMOVAL FROM THE MACHINE. THE "RG" IS STURDILY BUILT & DESIGNED TO BE OPERATED BY UNSKILLED LABOUR. IT REQUIRES THE MINIMUM OF MAINTENANCE

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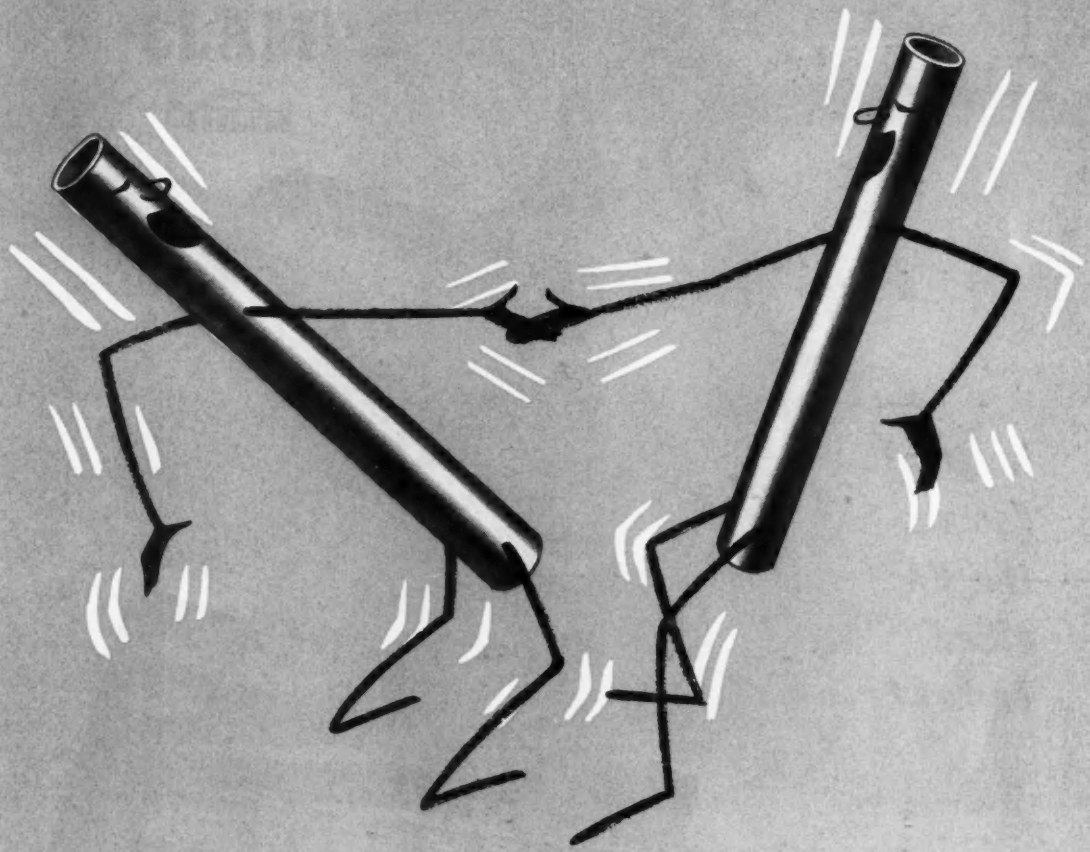

Tireless indeed! In hotels and houses, in radiators and refrigerators, on liners and tugs, millions of feet of I.C.I. copper tubes are faithfully doing their job, day in, day out.

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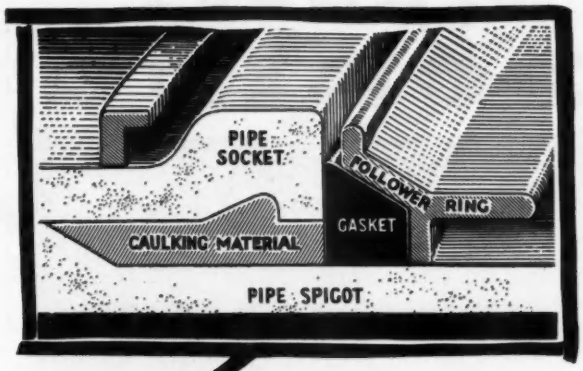

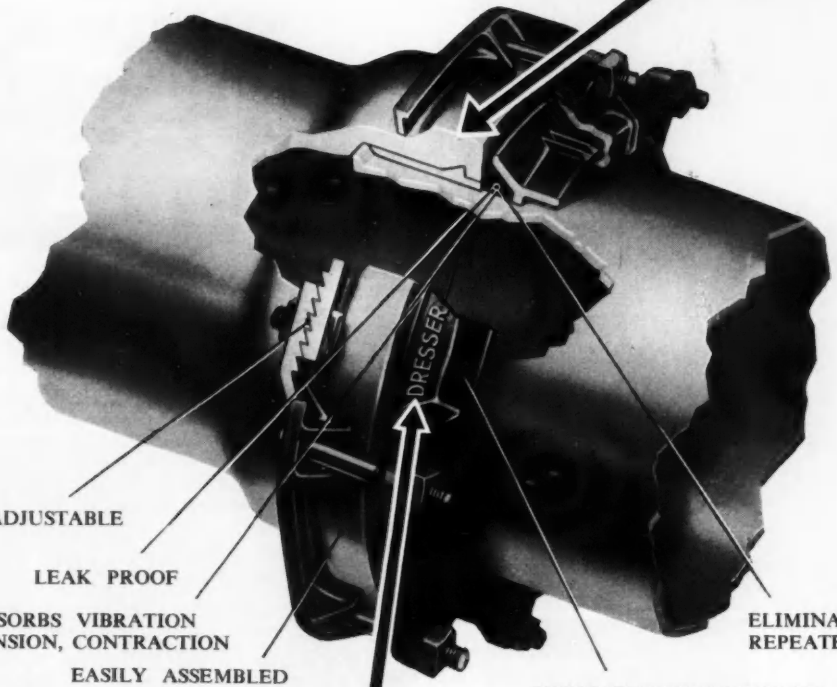

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The above illustraticns show hand and power operated Pass Hydraulic Thrust Boring Machines in action.

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A new concept in 4-tool, fast-towing plant! Higher output, Ackerman-type steering, over-run brakes, pilot unloader governing engine speed, and exclusive BRISTOL pannier type cowling. All these are added to the proved superiority of the famous BRISTOL two-stage double acting compressor design with BRISTOL intercooling—which add up to give more usable air per unit of running cost than any other machine.

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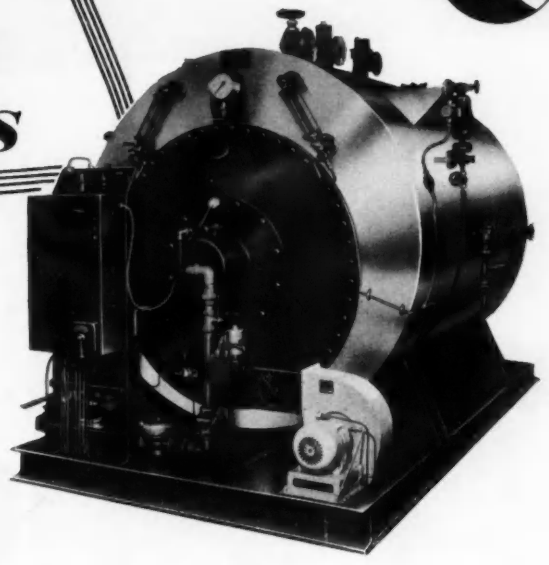
Swirlyflo Tubes



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FULLY AUTOMATIC

A packaged boiler is a complete steam producing unit, wherein the boiler, fuel burner, draught system and feed water tank are completely self-contained on one chassis.

Spanner Swirlyflo packaged boilers are available as vertical boilers as well as horizontal.
Vertical types are specially suitable for rapid steam raising and confined spaces. **250 lb. to 10,000 lb. of steam per hour.**

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Write for further details :—

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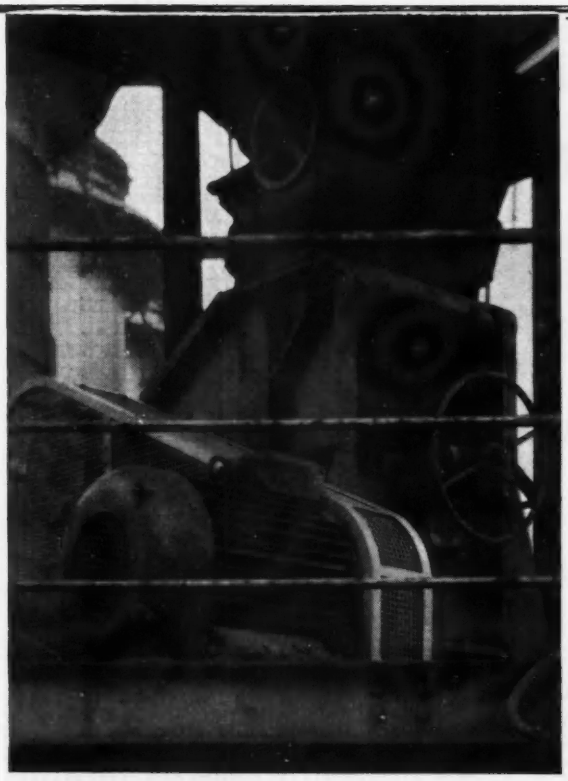

A fine installation for OXIDE CRUSHING

This installation at a large Midland Gas Works has a B.J-D Oxide Crusher, which is doing a really good job of work. Feed is by hopper, as shown in the picture ; discharge is on to a conveyor. The B.J-D Oxide Crusher is also available as a mobile unit, mounted on a bogie; the most recent version of bogie shows a considerable saving in cost, whilst still retaining the necessary strength and efficiency. We shall be happy to give you further details on request.

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SPECIFIC GRAVITY RECORDER
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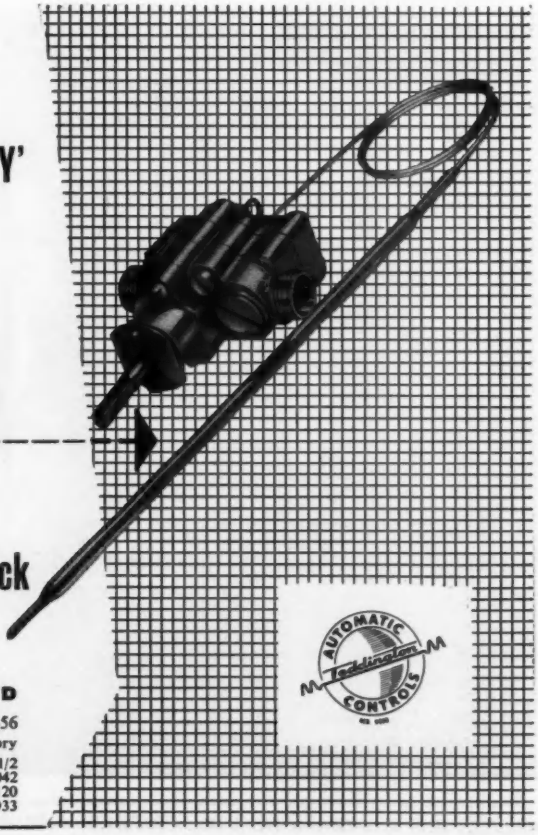

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crossword puzzle

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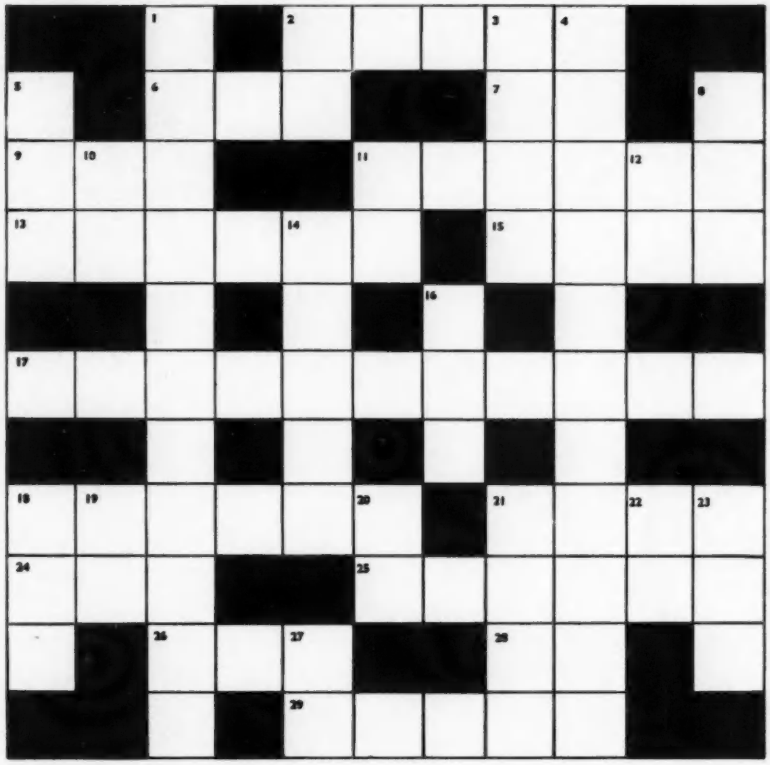

across

2. A portion is aloof
6. Evidence of resistance
7. Exclamation
9. Could be Bath or Chelsea
11. Keeps you out of trouble
13. Stop the flow—without a penny?
15. Shoe or family variety?
17. The name to be noted
18. 11 and 13 is only one of many types
21. This is the limit!
24. One pip
25. Types of 18
26. This nonsense in the woods may be dry
28. Old testament
29. Our "U" types are portable

down

1. Valves to adjust steam pressure
2. Before noon
3. This floater is 3 parts rear
4. Hot to a degree, with these
5. It's as simple as this
8. Not necessarily a deathly hue
10. W
11. Initially super fine
12. In short, time expired
14. Do you still go hot about an old one?
16. Estimated Time of Arrival
18. I can make a holy city after this
19. The very opposite of direct
20. This famous line has had an initial change
21. Late fruit?
22. Cockney call
23. lb/sq. in.
27. Firm initials

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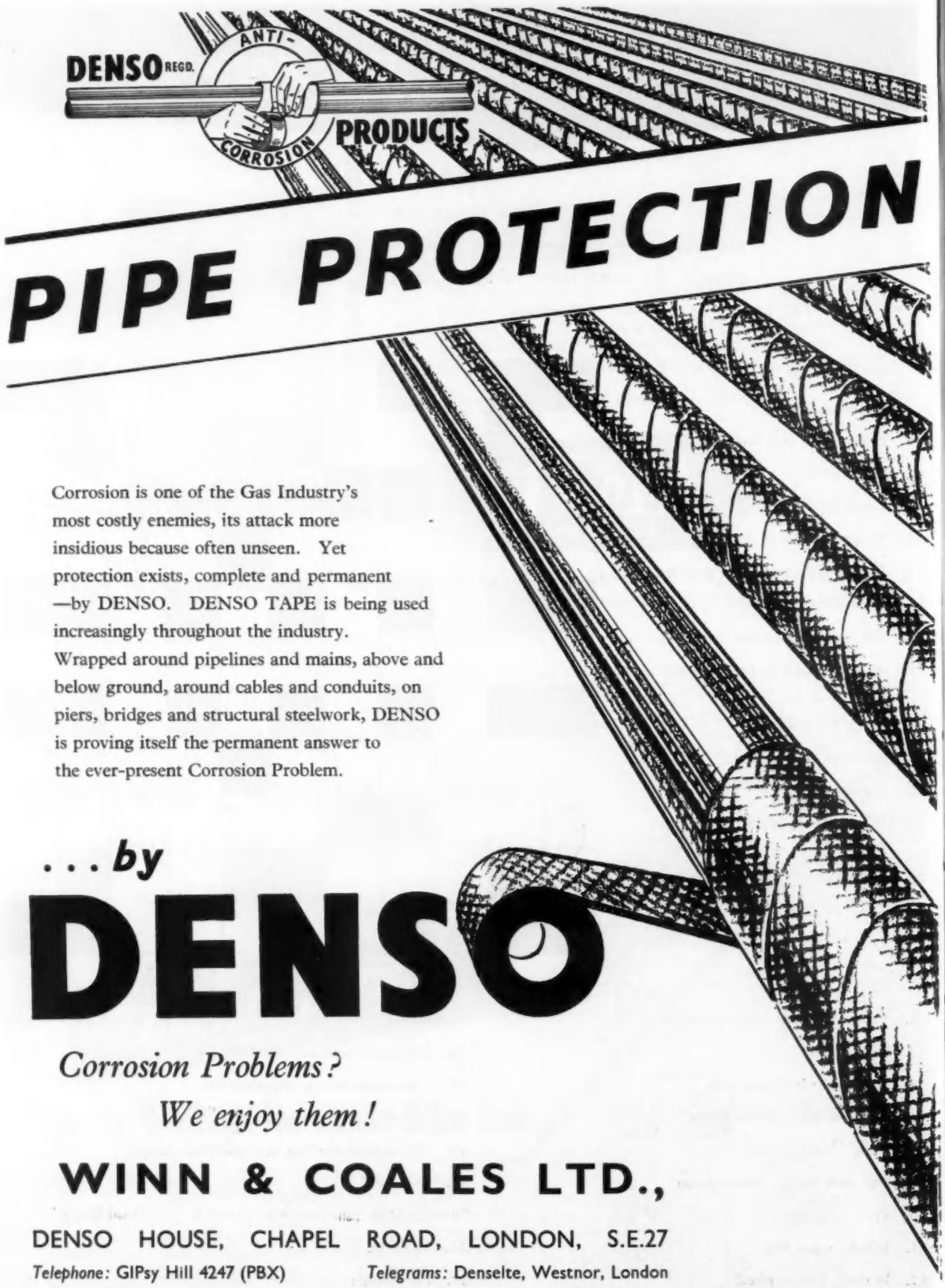

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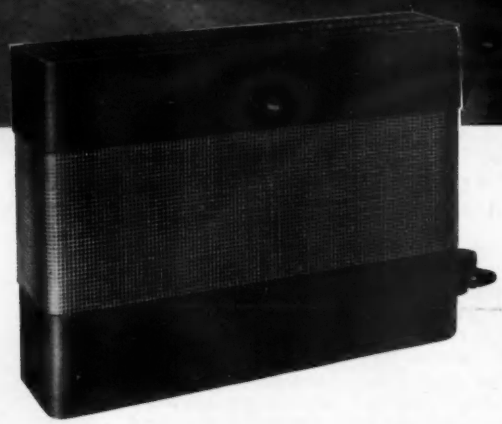

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Gas Journal

VOL. 290 NO. 4897 May 22, 1957

109TH YEAR

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94th ANNUAL GENERAL MEETING

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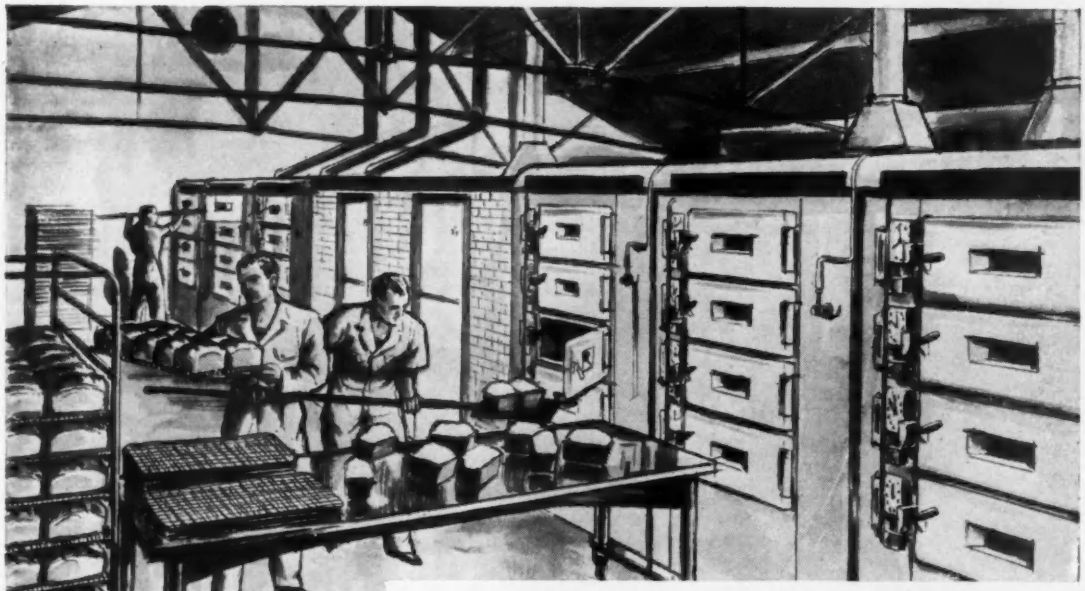

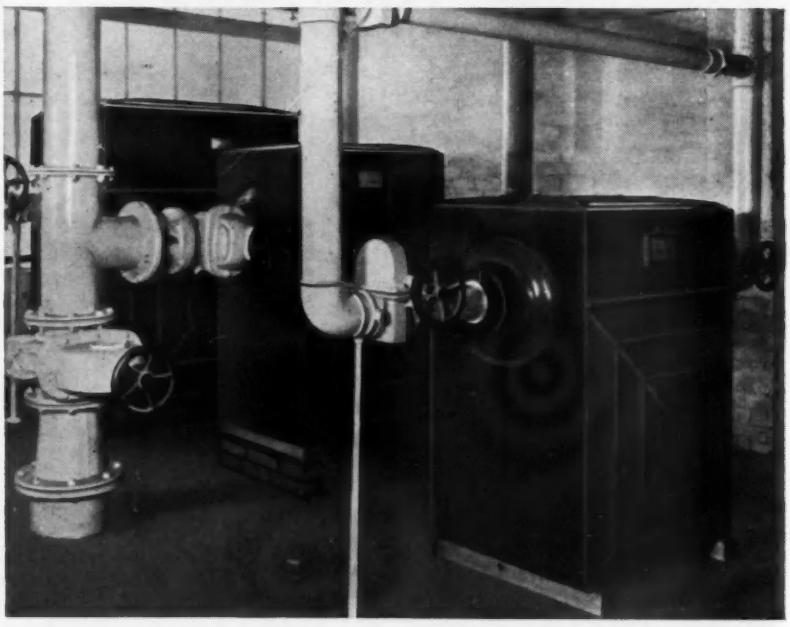

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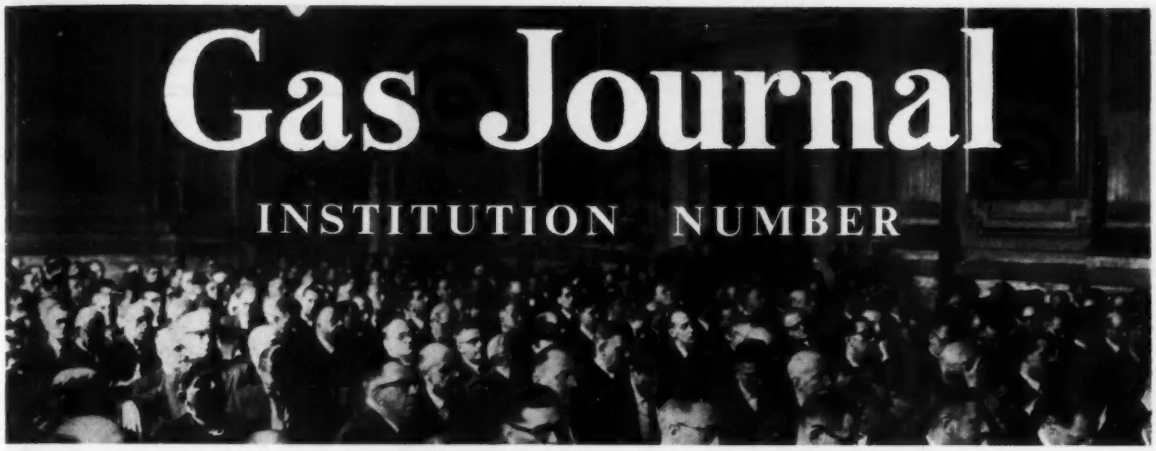


VOLUME 291 No. 4897 MAY 22, 1957

Our Impressions of the Meeting

THE 94th Annual General Meeting of the Institution of Gas Engineers might be described as a return to normality. After the somewhat unusual excitements of last year, culminating in the presence of the Duke of Edinburgh at the Royal Festival Hall to receive a scroll of honorary life membership, the 1957 meeting ran truer to the usual pattern. For one thing it was held at the Institution of Civil Engineers, a hall less modern and glamorous but one which benefited from its smaller size and consequently greater intimacy. In one respect at least this was the equal of last year's meeting—the commanding presence and facility of its President. As Deputy Chairman of the Gas Council, following a succession of important posts, Sir Henry has acquired to a considerable degree the art of public speaking, and this quality was a major factor in the ease with which the meeting was conducted. Not only is he an impressive and charming President but an eminently appropriate one in view of his family's remarkable connections with the gas industry.

A fine gathering marked the opening session when, after the Secretary, Dr. W. T. K. Braunholtz, had read the notice convening the meeting, the President announced that a telegram expressing our greetings and devotion to the Queen had been dispatched to Buckingham Palace. Sir Henry then welcomed the representatives and members from overseas. He mentioned Dr. M. Boselli, President of the International Gas Union, and the following official delegates of Overseas Gas Associations: Australian Gas Institute—Mr. J. R. Duggan, of Melbourne, Past President; Belgian Gas Association—Monsieur R. R. Touwaide, of Brussels, General Secretary; French Gas Association—Monsieur G. Nerot, of Paris, President; Italian Gas Association—Dr. E. Bertini, of Milan; Netherlands Gas Association—Mr. J. H. Steinkamp, of The Hague, Secretary; Swiss Gas Association—Mr. E. Delley, of Fribourg. Other overseas members and visitors included: Dr. A. Böhm (Turin), Monsieur F. Dupont (Paris), Mr. H. C. Hibberd (Wellington, New Zealand), Mr. E. Foster (Sydney), Professor C. Padovani (Milan), and Monsieur A. Papillon (Paris).

The Minutes of the 93rd Annual General Meeting, held in London on May 29 to June 1, 1956, and of the Special General Meeting (being the 22nd Autumn Research Meeting), held in London on November 20-21, 1956, were taken as read and confirmed.

The President then moved that the 94th Annual Report of the Council of The Institution of Gas Engineers for the year 1956-57 and the Accounts for the year 1956, be taken as read and adopted.

Mr. F. L. Atkin seconded the motion, and said that the Annual Report was noteworthy for the fact that it recorded that historic and memorable occasion when Prince Philip had graciously accepted the Honorary Membership of the Institution. Also, behind the simple statement that there were 82 Council

The President

Left: *Junior Vice President, President, and immediate Past President: Mr. E. M. Edwards, Sir Henry Jones and Mr. W. K. Hutchison.*

and Committee members lay a story of voluntary and willing effort on the part of many members to further the technical interests of the gas industry.

Election of Officers

The Secretary announced the following results of the ballot for the election of officers, auditors and ordinary members of Council:

President: Dr. James Burns, G.M., Chief Engineer, North Thames Gas Board.

Vice-President: Mr. Duncan D. Melvin, Member, Scottish Gas Board.

Auditors: Colonel Sir Harold Smith, K.B.E., D.L., Chairman, Gas Council, and Mr. Peter D. Davey, F.C.A., Wood, Drew & Company.

Hon. Secretary: Mr. G. E. Currier, O.B.E., Deputy Chairman, North Eastern Gas Board.

Ordinary Members of Council: Mr. G. Dougill, M.SC., Planning Engineer, North Thames Gas Board; Dr. A. E. Haffner, Chief Engineer, Southern Gas Board; Mr. S. K. Hawthorn, Divisional Engineer, No. 4 Division, Birmingham and District, West Midlands Gas Board; and Mr. S. L. Wright, Gas Engineer, Wales Gas Board.

Dr. Burns and Mr. Melvin briefly thanked members.

District Members of Council

The Secretary reported the names of the District Members of Council nominated by the District Sections of the Institution and affiliated District Gas Associations, for the year 1957-58, as follows: Mr. F. L. Atkin (Birmingham), Midland; Mr. J. W. Dean (Plymouth), South Western; Mr. A. H. Dyer (Newport), Wales and Monmouthshire; Mr. W. M. Gledhill (Stirling), Scottish; Mr. R. L. Greaves, M.B.E. (St. Helens), Manchester and District; Mr. T. McDougall (Londonderry), Irish; Mr. D. B. Parkinson, M.B.E., M.A. (London), Eastern; Mr. C. Stott, M.C., B.SC. (London), London and Southern; Mr. J. A. Tomes (Stourbridge), British Junior Gas Associations' Joint Council; and Mr. J. E. White (Newcastle-upon-Tyne), North of England.

The President proposed that scrutineers of ballots for the ensuing year should be: Mr. G. Dougill, Mr. S. K. Hawthorn, Mr. J. A. Tomes, and Mr. S. L. Wright. The motion was formally seconded, and carried.

Presentation of Medals

We came then to that pleasant ceremony—the presentation of medals and prizes. Sir Henry made the following awards:

Institution Gold Medal, 1956: Awarded to F. J. Dent, D.SC., M.INST.GAS E., F.INST.F.; R. F. Edge, B.SC.(ENG.); D. Hebden, PH.D.; F. C. Wood, PH.D., and T. A. Yarwood, B.SC., for the paper on 'Experiments on the Hydrogenation of Oils to Gaseous Hydrocarbons,' read at the 22nd Autumn Research Meeting of the Institution of Gas Engineers, in London, on November 21, 1956.

H. E. Jones London Medal, 1956: Awarded to C. Stott, M.C., B.SC., M.INST.GAS E., M.I.CHEM.E., A.R.I.C., for his paper on 'The Post-war Development of East Greenwich Works,' read at the 93rd Annual General Meeting of the Institution of Gas Engineers, in London, on May 30, 1956.

Institution Silver Medal, 1956: Awarded to I. J. Hartill, ASSOC.M.INST. GAS E., for his paper on 'Complete Gasification,' read at a meeting of the Manchester and District Section, in Huddersfield, on October 19, 1956.

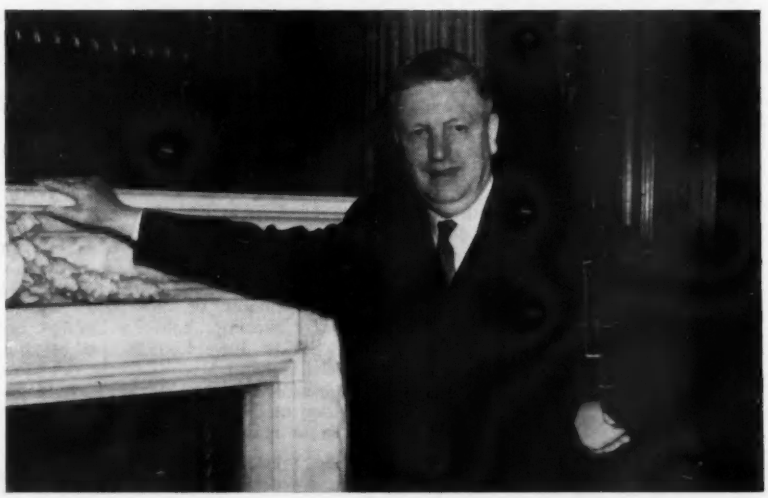
Institution Bronze Medal, 1956: Awarded to W. Lloyd-Ellis, B.SC., ASSOC.INST.GAS E., for his paper on 'Pipeline Butt-weld Inspection by Ultrasonic Methods,' read at a meeting of the Wales and Monmouthshire Junior Gas Association, in Monmouth, on November 20, 1956.

William Dieterichs Memorial Prize, 1956: Awarded to A. Higgs, M.INST.GAS E., for his paper on 'Gas is Competitive,' read at a meeting of the Midland Junior Gas Association, in Birmingham, on December 11, 1956.

Presidential Address

Sir Henry then gave his Presidential Address (published in last week's 'GAS JOURNAL').

Voicing the meeting's thanks to the President, Mr. T. C. Battersby commented on the fact that he had worked under Sir Henry's father for many years. During that period he had soon become conscious of the high esteem in which the family was held and had learned what the surname 'Jones' meant to the gas industry, both in this country and overseas. Sir Henry had made an early impression on the gas industry. It was well authenticated that the news of his arrival in this world was conveyed to his father while attending a board meeting at Watford. On cycling in haste back to London to greet his son and heir, the father and cycle parted company and came to grief when the wheels became fixed in the tram lines. A lot of gas had passed through the mains since Sir Henry's name first appeared in the minutes of a board meeting and since the time when directors journeyed to and



Right: *Senior Vice President, Dr. James Burns.*

Right: *Not perhaps the power behind the throne, but certainly part of the secret behind the success; Mr. A. G. Higgins and Dr. W. T. K. Braunholtz.*

from their meetings on bicycles. It was their gain that Sir Henry had chosen to follow in the steps of his forebears and become the fourth generation to devote his talents to their great industry.

Mr. Battersby thought the President had had a more difficult year than many of his predecessors. It had been his task to maintain a balance between the calls of the Institution and kindred associations and the exacting demands of a nationalised industry. This, in some amazing way, he had succeeded in doing and, through his good offices and wise counsel, the two bodies would work in even closer relationship, to the advantage of each.

In the early part of his address the President had introduced a personal note. This was both interesting and heartening to everyone present, because in the minds of many there was a fear that in an industry as centralised as the gas industry was today, detached and impersonal relationships might displace that family atmosphere which often provided the impetus to their achievements.

Continuing, Mr. Battersby said that Sir Henry had viewed the industry in retrospect, assessed their current problems, and presented a vista of things to come. He had drawn a comparison between the duties and responsibilities of the engineer and manager of former decades and the wider knowledge the aspiring young engineer must now acquire to reach the highest positions. The President had himself demonstrated that the engineer could prove a successful leader and administrator but, in an age of specialisation, there were more contenders from other fields for the coveted appointments. These still demanded of the occupants all the characteristics of those great personalities who had left their imprint on the industry.

The Young Engineer

Much of the address had been directed to the young engineer, who would do well to study carefully the advice the President had given him and to grasp every opportunity to widen his knowledge beyond the limits of his specialised employment, particularly of the realms of accountancy and management. Today the future of gas was discussed both within and outside the industry with varying degrees of optimism and, perhaps, some pessimism. It must have been encouraging to the optimist and disconcerting to the pessimist to hear the President put this vitally important subject of the gas industry *vis à vis* other fuel industries in proper perspective. Within his address he had encompassed the field of competitive fuels and, he hoped, eradicated the seeds of pessimism which germinated in the minds of those who were susceptible to the romantic accounts of nuclear development, as cultivated by sections of the popular Press. In short, he thought the President was telling them that, in the future as in the past, the industry could still flourish and play its great part in providing the heat requirements of the nation if it preserved flexibility in its processes and its leaders, engineers and scientists could attain the stature of their predecessors.

A neat summing up, and members indicated that Mr. Battersby had indeed interpreted both the President's message and also their own appreciation in well chosen terms.

Seconding the motion, Mr. C. A. Gibson explained some of the ways in which he had been associated with the President and revealed the remarkable fact that Sir Henry, among many qualifications, was a qualified blacksmith's hammerman!

Dempster Travelling Fellowship

We came then to the first Dempster Travelling Fellowship Report, 'Aspects of Long-Distance Transmission of Gas,' by J. F. Day. The Fellowship was endowed in 1951 by Mr. Charles Dempster in memory of the late Robert Dempster, senior and junior, and John Dempster. The Institution of Gas Engineers is trustee of the endowment. The income from the endowment is applied in awarding, from time to time, a Travelling Fellowship to enable the holder to study, either in this country or overseas, technical developments of interest to the gas industry. Its award is subject to conditions to be issued by the Fellowship Committee. These may include the submission by the Fellow to the Committee of a report on visits made and developments studied during his tenure of the Fellowship. Mr. Day was awarded the First Fellowship for a two-month visit to Holland, Belgium and France in 1954, to study recent technical developments in those countries in the distribution of gas for town purposes. Unfortunately time did not permit a discussion on this remarkable piece of work.

Mr. Day was congratulated by M. R. H. Touwaide, the Secretary of the International Gas Union. As he said, the paper showed that the author had a comprehensive view of Continental practice regarding long distance transmission of gas. He continued: 'I should like to say how very pleased the President of the International Gas Union is to see the publication of this report. As you know, the International Gas Union has recommended, since the end of the war and again at its last Council meeting in February, the exchange of high rank personnel between the member associations. The Dempster Travelling Fellowship is the first definite step which has been taken in this connection and Professor Boselli wishes me to express to the trustees of this fellowship the wish that it should go on sending young gas engineers to the Continent. We shall always be ready to help the Fellows because we all realise the great interest there is for a young gas engineer to see how his colleagues have solved the problems which he will have to face during his career, and beyond that these travels will lead to an exchange of experience and to a better mutual understanding which will be of the greatest benefit to the gas industry all over the world.'

Brown Coal

The session concluded with the paper on the 'Pressure Gasification of Brown Coal at Morwell, Australia,' by Dr. R. S. Andrews. Since the author was unable to be present the paper was read by Mr. T. C. Finlayson. It described in some detail the gasification of an almost unique type of carbonaceous raw material by a most up-to-date process; the Lurgi process has not been applied to material of this type before. Plants in the Ruhr and South Africa are using either a caking coal or one of high ash content, but at Morwell the brown coal has neither of these characteristics, which indicates the diversity of application of the process. In the course of the discussion it appeared that although this type of coal can be mined at only a penny a therm, by the time it is dried, briquetted, and ready for charging into the plant, the cost of coal as charged is no less than seaborne coal delivered

to the retort house bunkers of a gas-works in Sussex. The cost of the gas made by this process does, however, compare favourably with gas manufactured by conventional processes elsewhere in Victoria.

After the President's Luncheon, which is described at length elsewhere in this issue, delegates reassembled to hear Mr. Charles Johnson, Coal Officer of the Gas Council, talking about 'Coal Supplies for the Gas Industry.' Without attempting to prophesy he nevertheless gave a valuable indication of what the immediate future may hold and in what way the industry could best adapt itself to changing conditions. In general he advocated a high degree of integration of large-scale production units, preferably associated with a system of storages of gas in bulk, an arrangement which would cheapen base load gas production costs and minimise peak loads.

Catering Appliances

By way of contrast there followed a utilisation paper. Once again the energetic Mr. E. W. B. Dunning had been invited to contribute something on his cooking appliance research at Watson House. The result, 'The Development of Catering Appliances,' lacked the wide interest of his recent offering on the domestic cooking load, but it held much of interest for those concerned with such matters. Not surprisingly, since most gas boards lack catering specialists, it was the makers who were the main contributors to the discussion.

So ended the first day's business, and delegates joined their ladies, who had been enjoying a tea party and an exhibition of fine china at I.G.E. headquarters, and prepared for the evening's festivities at Grosvenor House. All present must surely agree that the reception and dance was a great success.

The second day's business got under way with the President reading the reply received from Buckingham Palace to the loyal message sent by the Institution on the previous day. After which the meeting concentrated on 'An Approach to the Use of Oil Gas in an Integrated System,' in which Mr. L. P. Ingram, Chief Engineer, described the pioneer work which is going on in the South Western Gas Board's area to overcome some of the special problems which that particular Board has to face. Geographically the area is long drawn out with a multiplicity of small undertakings lately integrated, with the industrial loads centred round Bristol and Gloucester and far away from sources of suitable carbonising coal. The supply of gas to such an area needs to be very flexible and as the discussion showed, the import of seaborne raw materials from overseas is easier and cheaper than railborne coal. The plants described were mostly American in origin, some of them making their first appearance in either Great Britain or, indeed, Europe. The installation of a Gaz Integral plant which can gasify otherwise unsuitable coal mined in Gloucestershire, the gas from it being enriched by one of the American high calorific value oil gasification plants, shows a nice balance for coke production in accordance with the Clean Air Act.

Mr. Ingram described his paper as 'an unfinished symphony' since results of the plant were not yet to hand, but he added, 'preliminary results obtained certainly appear to justify our original optimism for a "finished symphony" to be played on a four or five manual organ, rather than a skiffle group rendering of "The Birth of the Blues".'

Benevolent Fund

After this hint of musical slumming we turned with relief to the solemn melody of the Annual General Meeting of the Contributors to the Benevolent Fund; this is fully reported elsewhere in the issue.

One wonders whether there may have been a hint of sly humour in arranging for Mr. Ingram's paper to be presented on the same morning as 'Meeting the Gas Load in the North West,' a paper stemming from a Board with very different ideas on gas manufacture. The authors, Mr. W. Hodkinson, Deputy Chairman, and Mr. F. Litler, Chief Technical and Planning Officer, contributed an admirable paper which, as our report shows, attracted some good discussion. Mr. Litler did the talking.

And so to the visits. After lunch the company took not to the boats but to the coaches and set forth for Watford, Ponder's End, Wandsworth, Aldenham, Luton, Fulham, Wisley, and Heaven knows where. One thing is certain—they all enjoyed it. For the evening the Institution had drawn members' attention to two operas and a concert, and although we have no information concerning the numbers participating, no doubt Mr. Ingram took his five manual organ along.

Winner of the H. E. Jones London Medal, 1956, Mr. C. Stott, Deputy Chief Engineer of the South Eastern Gas Board, chats to Mr. F. Bell, Distribution Engineer, Southern Gas Board.

Thursday, May 16, brought two papers a little different in character from the usual run. Much has been written—and even more said—in recent years about 'the dead hand of the accountant' and it is indeed a fact that accountancy has played a much greater part in gas industry policy since nationalisation. 'Gas Industry Finance' by Mr. Wilfred Bailey, the chief accountant of the Gas Council, was therefore a successful enough choice for an Institution paper and despite what Lord Bruce had said about accountants at the luncheon, namely that they were a menace, Mr. Bailey asked with the utmost innocence why it was that accountants were often such unpopular figures. 'To quarrel with accountancy,' he said, 'is to quarrel with economic calculation and thus to quarrel with Providence itself for not having supplied everything in such abundance that it can be had for the asking.' Certainly his paper served as a very convincing defence of accountants and accountancy; perhaps it was a pity that Lord Bruce could not have heard it. Weight was lent to the proceedings by the participation of such formidable figures as Mr. Diamond and Mr. Currier in the discussion, the former putting forward some remarkably interesting views on the domestic load.

The other unusual paper was 'The Application of Work Study in the West Midlands Gas Board' by Messrs. H. B. Bassett and W. J. G. Bryce, who practice their profession in the Birmingham and Walsall Divisions respectively of the West Midlands Gas Board. The authors were at pains to explain that work study was not a method by which more work was done but enabled employers to see just how work was being carried out; under no circumstances could it be regarded as an adequate substitute for good management.

Dr. Haffner Says 'Thank you'

Thus we came to the end of the business sessions except for one pleasant ceremony—the omnibus vote of thanks. This year the duty was performed by Dr. A. E. Haffner, the Chief Engineer of the Southern Gas Board, who mentioned first the representatives from overseas. Among the list of these eminent gentlemen was Dr. Boselli, President of the International Gas Union, whom they hoped to see in action next year—at least, those of them who could be spared from what had been said to be our declining gas industry! They hoped to come back from that visit with the story of a vigorous gas industry. Next, they thanked the Institution of Civil Engineers for their elder brother kindness in providing facilities for their meetings, but with the pertness of the younger brother he must say that they had been deeply impressed by their cane bottomed chairs! They also expressed thanks to the Gas Council for so many friendly gestures but most of all for sparing their Deputy Chairman to be the Institution's President. Thanks were due, too, to the three Area Boards in and around London for showing their recent developments. The dominant impression from those visits was the large number of younger people who were going to them. Their membership was increasing, the attendance at meetings was increasing, and he thought their age group was becoming younger and younger. That was particularly noticeable when it came to visits to various works. If they could get all these

A view of the platform. Dr. M. Boselli, President of the International Gas Union, is fourth from the left.

young people pushing in the same direction there would be nothing to fear for our gas industry.

Dr. Haffner also expressed the company's thanks to the other bodies who had co-operated in the programme of visits, and then turned to the ladies and gentlemen assisting in the conduct of the meeting. At the highest level they had enjoyed the charm and friendliness of Lady Jones, but at all levels friends of the Institution had willingly undertaken tasks of all kinds to ensure the success of this meeting. Then there are the authors of the paper, who had concentrated long or unique experience into commendably brief papers which would influence decisions throughout the industry; these papers were the very bloodstream of the industry. Dr. Haffner referred also to the scrutineers of the ballots and to the officers, auditors, Council and Committees of the Institution for the wise and vigorous conduct of their affairs.

Feathered Friend

Finally, he came to the Secretary and staff of the Institution—to the Secretary who combined 'the wisdom of the owl, the gentleness of the dove, the vigilance of a hawk and the stateliness of the stork—and to his staff, a small efficient team each with individual personalities yet working together as a sweetly running machine kept well oiled by the Secretary, for whom they have the greatest devotion.'

Mr. D. Beavis, one of the comparatively small number of Scots present at the meeting this year, seconded the vote of thanks.

Dr. Boselli then briefly addressed the meeting in French, extending a warm invitation for as many as possible of the members of this Institution, with their ladies, to attend the International Gas Union's meeting in Rome in September, 1958, and then Dr. Braunholtz said a few, particularly well chosen words. 'It is on an occasion like this,' he said, 'that these junior members of the staff are given an opportunity of realising that the membership of the Institution is not just a file and a lot of names in a card index, but a body of lively and very human individuals.'

Proposing the vote of thanks and presenting the Presidential Certificate to the retiring President, Dr. J. Burns said that this particular week was but a culmination of a year's work for the President. It was perhaps only the members of the Council who were privileged to see how much the President had done during this year, and it was his meticulous attention to detail that had given the *tout ensemble* to a year which had been valuable and quite historic for the Institution.

Mr. W. R. Branson seconded the vote of thanks, after which Dr. Burns presented the Presidential Certificate to Sir Henry Jones. Sir Henry responded, and that concluded the meeting as far as the business sessions were concerned. However, it by no means concluded the Institution's 'outside activities,' and during the afternoon members were able to make their choice of the large numbers of visits already listed, while on Friday perfect weather graced the popular visit to Cambridge.

Obituary

DR. N. E. RAMBUSH, Chairman and Managing Director of the Power-Gas Corporation, Ltd., Stockton-on-Tees, has died aged 68. Dr. Rambush, who was born in Denmark, arrived in London in 1911 and became a partner in the firm of A. H. Lynn and Rambush, which was taken over in 1918 by the Power-Gas Corporation. Dr. Rambush was appointed Chief Engineer with the latter firm at Stockton, and in 1927 became Technical Manager of the Power-Gas Corporation, and its associated firm Ashmore, Benson, Pease & Co., Ltd., Stockton. In 1931 he became General Manager of both companies and seven years later was appointed Managing Director of both concerns. In 1947, Dr. Rambush was appointed Vice-chairman of the firms, and in 1951 became Chairman of the Power-Gas Corporation, Ltd., which had by then acquired the assets of Ashmore Benson. Dr. Rambush was one of the founder members of the Institution of Chemical Engineers, and between 1916 and 1952 he invented numerous patents connected with chemical and gas engineering. In 1948 Durham University conferred on him the honorary degree of Doctor of Science in recognition of his services to industry.

Diary

May 30.—WALES AND MON. JUNIORS: Visit to the Stanlow Refinery. 10.30 a.m.

May 31. — LONDON AND SOUTHERN JUNIORS: Meyerstein Theatre, Westminster Hospital School of Medicine, Horseferry Road, London, S.W.1. Annual Business Meeting. 6.30 p.m.

June 1.—EAST OF SCOTLAND JUNIORS: Golf Outing. Perth.

June 3/4.—EASTERN SECTION, I.G.E.: Skegness. A.G.M. 'Application of Electricity in the Gas Industry,' by R. Hutchinson.

June 4.—INSTITUTION OF CIVIL ENGINEERS: A.G.M.

June 4.—INCORPORATED PLANT ENGINEERS, MANCHESTER BRANCH: The Engineer's Club, Albert Square, Manchester. 'Air Compressor Maintenance and Installation and Ancillary Equipment,' W. McMillan. 7.15 p.m.

June 4.—INCORPORATED PLANT ENGINEERS, LONDON BRANCH: Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2. 'The Training of Plant Engineers,' J. Wilson. 7 p.m.

June 4.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster, London, S.W.1. 11 a.m.

Aspects of the Long-distance Transmission of Gas

By J. F. DAY, B.Sc., Assoc.M.Inst.Gas E.

An Appreciation of the First Dempster Travelling Fellowship Report

THROUGHOUT the majority of its history the British gas industry has relied upon cast iron pipes for the conveyance of its main product, but the reorganisation of the industry on an area board basis in May, 1949, has been a prelude to the gradual increase in the use of welded steel pipelines for bulk transmission purposes. This is a logical trend for this type of pipeline where the ultimate, or even the initial, working pressure is considerably in excess of the safe working pressure of the modern spun iron pipe.

In his first Dempster Travelling Fellowship Report the author gives full details of impressions and information gained during a two months' visit to Holland, Belgium and France in 1954 on aspects of the long-distance transmission of gas through steel pipelines with welded steel joints. The major problems experienced today on the Continent, as reported by the author, are no different from those which have always been inherent in steel pipelines laid underground, namely, corrosion and the efficiency of the joints. Costly steel pipeline failures arising from the effects of corrosion, and particularly in oil pipelines, has resulted not only in improved external protection methods but also in the growing application of cathodic protection either by impressed current or by the installation of sacrificial anodes. This type of protection, when allied with a sound pipeline coating, does give a satisfactorily protected steel pipeline whose life should at least equal that of spun iron.

The author gives some interesting comments on the comparison between the use of blown bitumen and plasticised coal tar as alternatives for pipe coatings. The advantages of plasticised coal tar are itemised and will receive support in this country where certain disadvantages in the use of blown bitumen for the protection of steel tubes are becoming apparent, although it is fair to state that the blown bitumen protection when used with glass fibre in place of hessian represents a considerable advance in protection methods.

With one exception—the Eastern France to Paris line—Continental pipelines have been laid with factory-coated pipes. This follows the practice in Britain, with one or two exceptions, notable among them being the grid lines laid in Wales where line coating methods, as developed in the U.S.A., were used. This line coating method is normally only possible where long lengths of pipeline are laid in open country and where a long 'spread' of operations can be carried out on a continuous basis. Apart from the laying speed, the important advantage of this method is that damage to the protective coating by constant handling and by transportation from the factory to site is avoided.

'Holidays' in Pipe Coatings

The author's reference to the detection of 'holidays' in the pipe coatings by the application of a high voltage applied between a free moving electrode and the pipe metal is important, particularly where factory-applied coatings are used. Externally protected steel pipes which of necessity have been transported and handled over a considerable distance from maker's works to site often show few outward signs of damaged coating but faults in the protection which may not be obvious are readily located by the method outlined by the author. Upon examination it is frequently found that the coating has become separated from the outer wall of the pipe leaving a partial void which would most likely enable a source of corrosion to become established or, alternatively, would be the cause of increasing the amount of current required

The development of cathodic protection both by impressed current and by the use of sacrificial anodes is set out in the report in an interesting manner. Particular attention is paid to this aspect of steel pipelining in France and Holland but in Belgium the faith in cathodic protection is such that the quality of coatings has never received particular attention. However, the author rightly draws attention to the fact that as no pipeline coating can be considered free from faults, then logically the electro-chemical nature of corrosion should be counteracted by sealing any faults electrically by cathodic protection. If, therefore, the coating of a steel pipeline is or becomes ineffective, then to remedy the defect will become costly in the amount of current used in sealing the faults in order to afford full protection against corrosion.

Unfortunately in this country the use of impressed current for cathodic protection is fraught with difficulties and so far public utilities have generally been unable to agree terms and conditions under which it would be possible for a utility service to apply impressed current to protect a particular pipeline where corrosion is active. Consequently, except in a very few isolated cases where the use of impressed current has been possible, sacrificial anodes are more commonly used as a means of combating corrosion, but it is open to doubt whether full and satisfactory protection is always achieved by this method.

Of supreme importance is the description of modern French practice to control the purity of the gas at the points of production and prior to introduction into the pipelines. The statement that price reductions are being proposed for gas accepted which is below specification is one which might well be considered in this country where gas is purchased from outside sources.

Continental Jointing Techniques

Jointing techniques on the Continent appear to cover those employed to a more limited extent than this country. It is notable that while up-hand welding is preferred in Belgium this seems to have been favoured technically and in relation to slower pipe laying in built-up areas where the greater speed of down-hand welding shows no economic advantage. In France, however, down-hand 'stovepipe' welding is becoming increasingly popular because of its inherent speed and to the fact that very few rejects have occurred after gamma-ray testing.

In regard to the effect on steel pipelines of ground subsidence following deep mining activities, Continental opinion is that there is no practical solution to completely obviating failures. Experiments in this country are proceeding jointly with the National Coal Board with a view to reducing the risk of failure of cast iron pipes by the installation of flexible fittings in selected pipelines at risk. However, sharp changes in ground surface levels, especially at geological faults, impose such heavy strains and stresses that no precautions could be guaranteed to be completely successful. This point is similarly recognised in Continental steel pipeline practice where special expansion bellows are now being developed in an attempt to reduce the risk of pipeline failure.

The testing of welds on high-pressure gas lines is considered essential, particularly in Holland, and to a lesser extent in Belgium and France. It is notable that 'ultra-sonic' testing is gaining popularity over gamma-ray testing owing to its greater efficiency and its speed in determining the soundness or otherwise of the weld. The provision of valves on Continental pipelines is carried out largely by the use of lubricated plug type valves at approximately five mile intervals buried direct into the ground without the use of pits. This method of installation follows the general practice in this country where experience has shown that the provision of a valve pit is uneconomic and carries certain undesirable safety risks.

Inferential metering of grid lines is not so far acceptable on the Continent and this again compares with practice in this country where the 'Connersville' meter is commonly used to measure volumes pumped into gas grid systems.

The report finally concludes with a very interesting method of steel pipeline repair as practised by the Distrigaz Company in which flame cutters are used for severing a main carrying a controlled positive pressure of between 2 in. and 3 in. w.g. It has been proved that this method is quicker and, consequently, cheaper than the accepted method of first purging the pipeline followed by flame or other cutting methods. In addition, of course, excessive gas loss is avoided. It is noted with interest that operatives are provided with suitable asbestos clothing.

Abstract of I.G.E. Communication 503

Pressure Gasification of Brown Coal at Morwell, Australia

By R. S. ANDREWS, D.Sc., M.I.Chem.E., F.R.A.C.I., M.Inst.,F.
CHAIRMAN AND MANAGING DIRECTOR,
GAS AND FUEL CORPORATION OF VICTORIA.

THE State of Victoria, Australia, possesses large deposits of brown coal, which, owing to the small overburden, are cheaply and easily won. The bituminous coal reserves are only 12 mill. tons. They are low in volatile matter and high in ash. On the development of the brown-coal reserves depends Victoria's industrial future. The Gas and Fuel Corporation has been entrusted with the task of gasifying this material and transmitting the gas by long-distance high-pressure pipeline 103 miles to the City of Melbourne. Towns along the pipeline route will also be supplied and, later, brown-coal gas will be supplied to the principal country centres of the State.

With the passage of time, it becomes necessary for industries to make changes, so that they may progress and adequately cater for the needs of the community. On one hand, these changes may lead to gradual introduction of new techniques, while on the other, circumstances may force the abandonment of conventional thinking and procedures, resulting in revolutionary changes in one courageous step. Examples of the latter type in industrial processing are not uncommon. The peculiar circumstances prevailing in Victoria, Australia, that led to the abandonment of carbonisation, in favour of high-pressure gasification, were caused by the nature, distribution and longevity of coal reserves. As the result of a detailed study of these conditions, the Gas and Fuel Corporation erected a Lurgi high-pressure gasification plant on the brown-coalfield at Morwell, 93 miles from Melbourne. In order to understand the reasons for such a step, some appreciation of the local background is essential.

Australia's main coalfields lie in the East and South-east coastal regions which areas contain approximately 80% of the population.

While these reserves are not as high as those of Great Britain, they are considerably higher per head of population. Apart from the coals in New South Wales, and those in a few areas in Queensland, the remainder of Australia's reserves are non-caking coals.

Supplies from New South Wales

At the present time, 77% of the requirements of the Australian continent are being supplied from New South Wales. The gas coal that is used by all undertakings in Australia, except those in Southern Queensland, comes from the Greta seam on the Maitland coalfield, 40 miles west of the City of Newcastle. Until recently, and for a period of approximately 70 years, this was the largest producing field in the country. The coal is reputed to be one of the richest in the world, and the seam reaches a thickness of 32 ft. 10 in. While Australian coals are comparatively cheap at the pit mouth, some less than £2 per ton, transport costs have increased approximately 450% since 1939. These conditions, and expansion of industry throughout the Commonwealth in post-war years, have demanded development of coalfields in other States. As Victoria is the second most highly industrialised State, it would seem logical that the first field upon which to concentrate, should be the large brown-coalfield in the Latrobe Valley. This area is reputed to contain 31,000 mill. tons of brown coal, in places reaching nearly 1,000 ft. thickness. It thus becomes a necessity, in Victoria, to utilise brown coal in industry for power generation and for town gas production.

The geological age of this coal is Pliocene; thus it will be realised that it is young and immature. It is very earthy in nature, with high moisture and oxygen contents, very friable and highly reactive, which cause it very readily to ignite spontaneously, and it is non-caking This commodity should not be viewed merely as a low-grade coal, but rather as a cheap and easily won carbonaceous material which can, by drying and briquetting, be upgraded into a fuel that can compete with black coal in nearly all spheres of usage. It is a very different material to bituminous coal, and special equipment has to be devised for its efficient use. When this Latrobe Valley brown coal is devoid of moisture, it is one of the purest forms of coal in the world.

The high content naturally demands that its use in the raw state should be confined to the region in which it is mined, and as the moisture content has to be reduced, it is both of interest and importance to know something of the conditions in which the water exists. Brown coal possesses a complicated petrographical structure in a matrix of vitrain. In these circumstances, the water is bound in a multitude of different ways, which merge gradually from one into the other.

Moisture Content

First, there is moisture present on the surface and in cracks, which exhibits normal vapour pressure. Secondly, close to the micelles themselves, water molecules are adsorbed, and finally, there is some evidence that the micelles are made up of numbers of small crystallites, each of which may be composed of one or more hydrocarbon ring structures with side chains attached. Water is believed to be attached to the outside edges of these crystallites within the micelles, although not within the crystallites themselves. It is likely that the amount and condition of the water in the last two categories exerts a considerable influence on the briquetting properties of brown coal. The ease with which the brown coal spontaneously ignites necessitates special precautions in its handling, transportation and storage.

Manufactured-gas production throughout the world is almost exclusively dependent upon carbonisation of caking coals, with carburetted water gas an an auxiliary. When brown-coal or brown-coal briquettes are carbonised in bituminous coal equipment, the gas yield per ton is small, and its calorific value is low. The gas itself contains about 25% of carbon dioxide, which is costly to remove at atmospheric pressure by washing with potassium carbonate. Furthermore, a coke is not formed, but a soft friable highly reactive char that is difficult both to transport and market.

Prior to the second world war, the Metropolitan Gas Company of Melbourne embarked upon a research programme, extending over several years, into methods and techniques of brown-coal gasification. Two methods seemed to warrant examination, carburetted water gas production and combined carbonisation and water gas production in one unit, as conceived by Dr. Allner of the Didier Gesellschaft. A water gas unit, fully instrumented and supplied with a separate meter, was isolated from the other sets for the specific purpose of gasifying brown-coal briquettes. The air blasting rate employed on this unit when operating on coke was 4,800 cu.ft. per minute, and the thermal efficiency was in the region of 63%. Conditions such as these could not be maintained over a prolonged period as the fuel bed became blocked with fine, granulated brown-coal char, and efficiency and output deteriorated.

The findings of research into this field over a period of years may be summarised as follows:

(1) The briquette fragments carried over with the blast with approximately 4% compared with 0.5% when using coke.
(2) With low air blasting rates, which were inevitable owing to the friability of the briquettes, fine granulated brown-coal char gradually accumulated at the periphery of the generator, reducing output and thermal efficiency.
(3) In all tests the ash, which was mechanically removed, contained over 50% of carbon.
(4) The blow gases, when using briquettes, were approximately double the calorific value of those when using coke. This was due to the high reactivity of brown coal which gave rise to an abnormal quantity of carbon monoxide (22 to 29%) representing considerable thermal loss.
(5) As plant output was reduced from time to time in an endeavour to overcome the disability of briquette fragmentation, efficiency dropped. When throughputs were 40% or lower of the rated capacity of the plant, operations were hopeless from an economic point of view.
(6) The economic factor in water gas production is the rate of blast and this had to be reduced below the economic limit for even partially successful operation.

It thus appeared that the normal water gas plant, with a static fuel bed and operating on alternate blasts of air and steam, was unsuitable for the gasification of brown-coal briquettes.

Didier-Bubiag Process

The Didier-Bubiag process as developed by Dr. Allner was then examined. In this equipment, the gas, instead of being drawn off at the top, left the retort through an offtake two-thirds the way down the retort. While this retort was externally heated, steam was introduced at the bottom so as to convert some of the brown coal char in the bottom section to water gas. Thus, the carbonisation gas and water gas left the retort through the same offtake. The objectives in the design of such equipment were two-fold:—

(1) To permit of the cracking of the brown-coal tar in its downward passage through the upper portion of the retort, in order to increase the calorific value of the gas, and
(2) to convert sufficient brown-coal char to water gas so there would only be sufficient char for use in the producer to heat the retort.

The high carbon dioxide content of the gas was reduced by washing with potassium carbonate. In 1943, the research staff of the Metropolitan Gas Company designed and erected a model unit with a throughput of 10 lb. of brown-coal briquettes per hour.

The main conclusion of these experiments was that the tar content of Yallourn brown coal (7%) was too low for the production of a town gas richer than 400 B.Th.U. per cu.ft. by the Didier-Bubiag process, if a reasonable thermal yield were to be obtained. Finally, the economics of the process is dependent upon a satisfactory disposal of the residual char. It was found that when briquettes, with their comparatively high moisture content, are carbonised in an externally heated retort, stresses and strains are set up within the briquettes which causes them to fagment. The resultant char, owing to its reactivity and friability, would present difficulties in marketing.

In the Lurgi process, brown-coal briquettes are charged into the generator through a lock chamber. The briquettes are completely gasified under a pressure of 28 atm. by means of steam and oxygen. The ash is removed continuously through a rotating grate and discharged through another lock chamber. The oxygen used is of 95% purity, and the steam is super-heated to 500°C. These gasifying media enter through the grate. The gas leaves the generator at the top, passes through a pre-scrubber where dust is removed and the gas cooled below its dew-point. Tar and water contained in the gas are removed in pressure coolers, the first of which is in the form of a waste-heat boiler. Benzole is removed by oil scrubbing under pressure. Water washing of the gas under pressure reduces the carbon dioxide content of the gas to 2% and under this pressure 95% or more of the hydrogen sulphide is also removed. The remainder of the hydrogen sulphide is eliminated by passing the gas through iron oxide.

In developing pressure gasification, there is no doubt that the Lurgi Gesellschaft has made it possible for the gas industry to depart not only from conventional methods, but also from the exclusive use of caking coals. The bulk of the world's coal reserves are non-caking and these are now available for processing by a rapidly expanding gas industry. On the other hand, diminishing caking coal reserves can be conserved for the steel industry. In some countries, this is a factor of national importance.

For the development of Victoria's brown-coal resources there appeared to be no practical alternative to the adoption of the Lurgi process. The plant has been completed and is now in operation at Morwell on the brown coalfield 93 miles east of Melbourne.

Although the gas-generating section of the plant at Morwell has a capacity of approximately 30 mill. cu.ft. per day, the initial output will not exceed 15 to 18 mill. cu.ft. as sufficient brown-coal briquettes are not yet available, owing to delay in completion of the Morwell factories controlled by the State Electricity Commission.

The plant consists of six Lurgi pressure generators, two brown-coal-fired boilers with an evaporative capacity of 55,000 lb. per hour each, and two Linde-Fränkl oxygen units each capable of liquefying 500,000 cu.ft. of air per hour for oxygen separation. In addition to gas, 1 mill. gal. of tar and 300,000 gal. of benzole will be recovered per annum during the first stage. The brown-coal tar recovered is paraffinoid in nature, rich in waxes and phenolic compounds. The benzole consists of approximately 60% hydrocarbons of the aromatic series and 40% unsaturated hydrocarbons. The latter will be hydrogenated in the presence of brown-coal gas at 30 atm. pressure, using a molybdenum catalyst, in the vapour phase. The refined motor spirit has an octane rating of 85. Brown-coal gas, after purification under pressure, has no odour. For safety reasons, this is rectified by the addition of 0.7 gr. per 100 cu.ft. of tetrahydrothiophene.

Prevention of Internal Corrosion

Prevention of internal corrosion of the long-distance pipeline by dehydration of the gas is essential. In order that no deposition of moisture takes place, it is necessary to keep the dew-point below 55°F. in summer and below 40°F. in winter. Any attempt to reduce the dew-point by expansion would seriously reduce the storage and transmission capacity of the pipeline. Refrigeration, adsorption by dessicants such as silica gel and activated alumina, and absorption by hygroscopic liquids have been investigated. As the result of these investigations, it has been decided the only safe method of dehydrating under pressure is by means of absorption with either di- or tri-ethylene glycol. The latter was selected on account of its higher boiling-point and consequently lower vapour pressure. At a terminal station on the fringe of the metropolitan area and at the terminus of the high-pressure pipeline, the gas has to be rehumidified.

Gas for transmission under pressure, dehydrated to a dew-point of 45°F. at 380 lb. per sq. in., will have, on expansion to atmospheric pressure, the extremely low dew-point of about −20°F. Obviously, it is necessary to rehumidify this gas to the state of partial saturation at which the system is operating at present. The water content must be increased by about 460 lb. per mill. cu.ft., depending upon the temperatures prevailing. Naturally, this operation is carried out at the point of lowest pressure before the branching of the supply into many subsidiary mains. It is planned to bring production to 30 mill. cu.ft. per day by 1960, and to 60 mill. cu.ft. per day by 1965. As output increases at Morwell, black-coal plants in the metropolitan area will gradually shut down, with the exception of some carbonising and water gas plants at the major works at West Melbourne. Sales are increasing at the present time at the rate of 6 to 7% per annum, and new areas are being acquired. In a young country like Australia, which is on the threshold of rapid expansion, one can look with optimism to the future of the gas industry.

With the addition of one boiler, an oxygen unit and another water wash tower, at a total cost of £1.25 mill., the plant can be brought up to a capacity of 30 mill. cu.ft. per day.

The gas is transmitted, 103 miles, to Melbourne through an 18 in. steel welded pipeline. For the first 80 miles between Morwell and the terminal station, 20 miles from Melbourne, the pressure is maintained at 400 lb. per sq. in. From the

terminal station, the gas is conveyed through two 18 in. steel welded mains to two of the metropolitan works. These two mains pass through built-up areas; therefore, after leaving the terminal station, the pressure is reduced to 100 lb. per sq. in. The construction of the high-pressure pipeline was a unique accomplishment in engineering history in Australia. No pipeline of these dimensions and constructed to such rigid specifications had previously been laid in the Southern Hemisphere.

The brown-coal gas has a calorific value of 450 B.Th.U. per cu.ft., while the gas supplied in the metropolitan area is 500 B.Th.U. per cu.ft. Herein lies a major problem as they are not interchangeable. For the next five years, the brown-coal gas will be transmitted to the two of the metropolitan works where it will be blended with refinery gas, purchased from a nearby oil refinery, so that it will be interchangeable with the gas at present being produced. If this were not done, it would mean the adjustment of over 1 mill. appliances in the metropolitan area. There will, of course, be certain areas along the pipeline route which will only use 450 B.Th.U. per cu.ft. brown-coal gas, but these are small.

As black-coal gas will continue to be produced for some considerable time in the metropolitan area, it is essential that it be interchangeable with brown-coal gas in all domestic and industrial equipment. The means of ensuring this will be discussed later in the paper. When the two gases are rendered interchangeable, it is planned to construct a pressure ring main around the city, with feeder mains connected into the present reticulation system.

Teething Troubles

It is, of course, inevitable that in commissioning such a plant teething troubles should occur. Most of these teething troubles were of a minor nature. Two, however, required particular attention. These concerned the removal of ash and the mechanism for feeding briquettes to the generator. Apparently, the problem of ash behaviour is one that has been common in the commissioning of all Lurgi plants. This was solved by alteration to the ploughs and by experience gained in obtaining the correct steam:oxygen ratio in order to maintain the ash in a fine condition so that it could be readily removed.

The Morwell plant was the first one designed to operate on brown-coal briquettes. Initially, it was found that the mechanism in the coal lock chamber, which might have been suitable for coal of a specific size, caused trouble in the feeding of briquettes. Bridging of the briquettes occurred and in these circumstances it was not possible to feed the requisite quantity of fuel to meet the guaranteed gas output. This mechanism in the coal lock chamber had to be redesigned to meet the requirements of the specific fuel. At the time of writing, this has been done on two of the six generators with satisfactory results. It was planned to have all generators altered by April this year.

The Morwell brown-coal open-cut mine is not yet in full operation and the coal now being used is transported six miles from Yallourn North open cut with a moisture content of 48.2%.

When Morwell coal with a moisture content of 61% is used, the gross thermal efficiency will be 66%. The temperature of the superheated steam as it leaves the boilers is 650°F. It then passes through gas-fired superheaters where the temperature is raised to 950°F. This temperature has not yet been reached, and thus the quantity of oxygen used is greater than is considered normal.

Briquettes are now being used with a moisture content of 16.4%, ash of 1.5% and a volatile matter content of 41.6%. At present, two generators are in operation, No. 1 and No. 6. No alterations have been made to No. 1, while No. 6 has had the necessary modifications made to the grate and coal lock chamber. Although the guaranteed output per generator is 3 mill. cu.ft. per day, No. 1 has only been producing an average of 2.3 mill. cu.ft. per day, and No. 6 after modification averaged 5.5 mill. cu.ft. per day and for a short period produced 7 mill. cu.ft. per day.

Hydrogen sulphide is completely removed by pressure water washing. Production data at this juncture, though of interest, are meaningless. The target performance has been set and the production staff are confident that this will be attained in the next few weeks.

The Linde-Fränkl oxygen plant has operated satisfactorily; both units have operated continuously at their guaranteed performance producing 95% oxygen at the rate of 102,000 cu.ft./hour with a flexibility ranging from 60% to 115%. The calorific value of the gas is to a large extent determined by the reactivity of the fuel, and to a lesser degree by the tar content. As the tar content of Yallourn brown coal is approximately half that of the brown coals in Eastern Germany, the calorific value of the gas is 30 to 35 B.Th.U. per cu.ft. lower.

The entire project cost, £11.7m. This includes the works at Morwell, the one mile conveyor system to bring raw coal and briquettes from the new Morwell open cut when opened, and from the Morwell briquette factories when erected, the 103 mile pipeline and terminal station, automatic blending equipment at two metropolitan works, and the capitalisation of interest during construction.

The cost of briquettes includes 9s. per ton freight from Yallourn, six miles distant, which will be eliminated when Morwell factories are operating. The raw brown coal now coming from Yallourn is double the price on to the conveyors of that which will soon be coming from the Morwell open cut. Maintenance charges should diminish after the present running-in stage is over, but these cannot be accurately assessed at present. The value shown for return on by-products is considered to be low, as at present only crude products are marketed. It must also be borne in mind that the pipeline is capable of transmitting to Melbourne 90 mill. cu.ft. of gas per day, and interest and depreciation are charged on the full capital cost. This applies also to the conveyor system and several sections of the plant that have been built to cope with an output of 60 mill. cu.ft. per day when the plant is extended. For these costing purposes, the gas output per generator has been taken as 5 mill. cu.ft. per day. It has previously been mentioned that 7 mill. cu.ft. per day has been reached on one generator, and it is anticipated that within 12 or 18 months 9 mill. cu.ft. per generator per day will be possible. The conservative costs per 12, 15, 18 and 30 mill. cu.ft. per day are 9s. 4.61d., 8s. 2.44d., 7s. 4.65d., and 6s. 3.34d., respectively, per 1,000 cu.ft. of gas made.

The largest of the three Metropolitan works carbonising coal, West Melbourne works, has a capacity of 25 mill. cu.ft. per day and produces the cheapest gas as the coal is delivered from the ship's hold by conveyors to the works bunkers. Coal for the other two works has to be transported by road from West Melbourne, thus increasing cost of gas production. The net cost of gas production at West Melbourne works is 6s. 8.35d. per 1,000 cu.ft. of gas made.

In the economic consideration of the project, there are certain factors that had to be taken into consideration. These were, the dwindling reserves of gas coal in New South Wales, the dependence upon gas coal from another State, and the rapidly increasing freight charges. In 1939, freight on coal from Newcastle to Melbourne was 5s. 9d. per ton; today it is 33s. per ton. Economically, the gasification of brown coal in Victoria was not a venture, but a necessity. It would appear, from information already possessed, that when production at Morwell reaches 25 to 30 mill. cu.ft. per day gasification of brown coal by the Lurgi process will be more economical than conventional methods using bituminous coal.

Planning for the Future

Plans for the next ten years not only include raising the capacity of the plant from 30 mill. cu.ft. to 60 mill. cu.ft. per day, but also the production of 'hard char' from brown-coal briquettes, the synthesis of products from brown-coal gas, and consideration to be given to the development of high-capacity gasification units. These three possibilities will now be discussed.

The attractive properties of this 'hard char' are the low ash and sulphur contents, being 4% to 5% and 0.25% to 0.45% respectively. The bulk density is approximately 20% higher than that of normal metallurgical coke.

In 1955, a pilot Spühlgas plant, of modified design, was erected by the Gas and Fuel Corporation on one of its metropolitan works and operated by the University research students. It processed 1 ton of briquettes in 36 hours. The object of this pilot plant was to produce sufficient tonnage of 'hard char' for testing its value in large-scale operation. A long series of tests were conducted in a cupola in a Melbourne

foundry. This new fuel is highly reactive and has been found to be very satisfactory in slow-combustion stoves. Non-ferrous metallurgical industries have also displayed considerable interest in its use. The Gas and Fuel Corporation is at present, therefore, erecting a semi-commercial unit at Morwell with a capacity for processing 25 tons of briquettes per day. The output of this plant will permit of large-scale trials in many metallurgical industries. It is confidently expected that the market will warrant the erection of at least one modified Spühlgas unit with a throughput of 400 tons per day.

With recent developments and conceptions in coal processing, it would appear certain that pressure gasification has come to remain as part of a new chemical pattern in gas manufacture. The synthesis of products from the gaseous constituents becomes attractive as a means of gas price reduction for two reasons:

(i) the gas is already under pressure; and
(ii) with the introduction of complete gasification there is no coke production.

The introduction of synthesis into the gas industry is a departure from conventional thinking and practice. A modern Lurgi pressure-gasification plant may be viewed as the basis of a chemical and fuel industry. The particular plant in question produces the cheapest hydrogen, carbon monoxide, nitrogen and carbon dioxide in the country.

It must be obvious that any form of gas enrichment which does not produce profitable saleable materials, other than gas, should not be considered: for example, the synthesis of methane from the carbon monoxide and hydrogen in the gas must increase the cost of gas production and not reduce it. The removal of constituents of the gas, possessing low heating values, for the synthesis of marketable products would appear to be an avenue that would warrant serious consideration. The economics of two procedures are now being examined. These are the removal of some of the hydrogen in the gas for ammonia synthesis and thence to urea, and Fischer-Tropsch synthesis. As the gas is already under 28.3 atm. pressure, ammonia synthesis becomes attractive, particularly as Australia is not yet self-sufficient in production of nitrogenous fertiliser.

Whether the step from ammonia to urea is to be taken is dependent upon the results of fascinating experiments being conducted at present in Australia on feeding sheep on urea to increase the wool yield. The production of liquid fuels by Fischer-Tropsch synthesis by the gas industry in Australia is worthy of serious investigation.

In the synthesis of liquid fuel by the Fischer-Tropsch process, 70% of the cost of the liquid fuel is in the initial gas manufacture. In the combination of town gas and liquid fuel production, the hydrogen and carbon monoxide contents of Lurgi gas are caused to unite catalytically to form liquid hydrocarbons, concentrating the unaffected methane in the residual gas. Approximately one-third of the heat units in Lurgi gas are converted to liquid fuel, and two-thirds into the form of rich gas for town distribution. The rich gas would have a heating value of approximately 900 B.Th.U. per cu.ft. and could be used for raising the calorific value of the brown-coal gas to 500 B.Th.U. per cu.ft. or more.

There is the disadvantage, of course, that liquid fuel production is largely confined to town gas consumption. On the other hand, there is the very distinct advantage that the costly gas-making plant is already provided for. This latter factor renders this dual process worthy of consideration.

Another and equally important factor to be taken into consideration is that, apart from the three peak winter months, gas-making plant is idle. In the hot summer months, the plant lying idle represents approximately 40%. It is intended to explore the possibility of utilising all available gas-making plant to full capacity, and to use for liquid fuel synthesis the gas that is not required for town supply. In this case, the methane would have to be catalytically dissociated to carbon monoxide and hydrogen. It is felt that these techniques should be understood in Australia and that the dual process of gas manufacture and liquid fuel synthesis offers the most economical method for their introduction. The development of a high-capacity gasification unit is at present only in the literature search stage. The precise position in this State is that there exist vast deposits of brown coal, with little overburden, which can be easily and cheaply won. It is obvious that the gas industry in Victoria must, as soon as practicable, take advantage of the availability of this cheap raw coal for gasification purposes instead of paying £3 10s. per ton for the briquetted product.

The cost of drying brown coal, and of screening it to the correct size for use in a static bed, is nearly as great as that of drying and briquetting. It must thus be obvious that the aim for the future is to gasify this cheap carbonaceous material in a pulverised condition. For this purpose, a unit with high capacity and comparatively low capital cost should be developed. This would require a new chemical engineering pattern in gas manufacture.

DISCUSSION

Dr. F. J. Dent (Director, Midlands Research Station, Gas Council) said that the adoption of pressure gasification with the introduction of a new type of gas, by an undertaking with an average output of only 35-40 mill. cu.ft. per day, would be a bold plan in any circumstances. It was far more so in Australia, with its isolated and limited native resources, but even a brief sight of the country brought it into perspective since works of similar size were seen to be under construction on every side.

The Latrobe Valley itself was a hive of activity and besides the gasification plant, there were the erection of new power stations, briquette factories, chemical works and the like, and even these were dwarfed by the magnificence of the open cut itself, as it exposed the huge thickness of reactive coal with only 2% of ash which could be mined at 1d. per therm. As such, it represents one of the cheapest sources of carbonaceous material in the world and, in a country which was rapidly expanding its industrial activity, the imperative necessity of using gasification techniques in the development of such an indigenous resource seemed to be quite obvious. Pressure gasification was rightly chosen as opening up more possibilities for the future.

There were wide differences between the fuels which are used in the three installations which had been erected since the war. South Africa operated with a bituminous coal, completely non-caking, and containing 30% of ash. Germany used a medium caking coal—quite strongly caking under pressure—with 20% of ash. In Australia, however, the fuel was brown coal, as briquettes, not specially made for gasification, and with so little ash that there had been some difficulty in maintaining adequate temperatures round the grate to prevent condensation. There was no doubt that the difficulties now experienced would be overcome and that the performance will eventually exceed expectations, as it had done in both South Africa and Germany.

It was a feature of Australia that the costs of imported plant were very high due of course, to the cost of transporting it there and, secondly, to the need for providing what to us would be excessive stand-by capacity. This was particularly so with this new type of gas-making plant which, to meet an immediate gas demand of 15 mill. cu.ft. per day, had generator capacity of 50 mill. cu.ft. per day with oxygen plant and gas treatment plant for 30 mill. cu.ft. per day. This meant that the estimated figures for the cost of gas production was of little general significance until an output of 30 mill. cu.ft. per day had been attained and, for that output, the estimate was 17d. per therm in Australian currency.

It seemed high—fantastically high in comparison with the cost of the raw brown coal and with the gas/coal price ratio of 2.5 which was attained by the Lurgi process operating in Germany. But is it too high?

There were, however, one or two disturbing thoughts. The first was that, while the raw brown coal was mined at 1d. per therm, its price increased more than three times during drying and briquetting by the State Electricity Authority. As it entered the gasifiers, it was not a particularly cheap fuel. In comparison, the raw brown coal could be fed directly to power station boilers and domestic electricity was available at 1½d. per unit.

Secondly, the brown coal briquettes which were used for gas-making can be supplied directly to domestic and industrial premises and were being manufactured primarily for this purpose. Highly reactive and low in ash, they were becoming popular for space heating and water heating.

Thirdly, distribution charges of gas were not particularly low. Consumption per head of population was only half that in this country and the 1½ mill. population of Melbourne were spread over an area as large as Greater London. Domestic gas sold at about 30d. per therm.

That both power and solid fuel supplies benefited from the brown coal deposit underlined the necessity of taking advantage of it for gas-making, and it was clear that the competitive position called for everything possible being done to minimise costs of production. With the high moisture in the coal and the high cost of plant it was probably too much to expect as low a price ratio as in Germany, but there would have to be some savings in the drying of the coal and in the high cost per therm of gas of purchased power.

Dr. Andrews visualises high capacity gasification units using the brown coal in the pulverised form, as well as extensions into synthesis and hard char production. He is looking to research to develop these processes.

High Cost of Raw Material

Mr. W. K. Hutchison (Chairman, South Eastern Gas Board) said that the most unexpected feature of the facts discussed about the Morwell project was the high cost of the raw material. The brown coal briquettes at present available to the plant cost £3 10s. a ton, equivalent to 4.2d. per therm of potential heat content. This must be higher than the equivalent cost of gas-making coal in England at works situated near coal fields, and was only slightly less than the figure of 4.52d. per therm, which he had extracted from the cost sheets of six selected stations in south-eastern England, which had a combined daily output of 180 mill. cu.ft. of gas, where most of the coal used had to be brought more than 200 miles by sea.

It was, of course, difficult to compare costs even between two plants of similar type working in the same country, and to attempt comparison between the costs of the new plant at Morwell and those which might be estimated for a plant operating in England would probably be a waste of time. Moreover, the Morwell plant could not yet be judged on a fraction of the designed output.

Gross material costs for the conventional plant at Melbourne amounted to 19.2d. per therm of gas against 8.5d. per therm of gas for the Lurgi plant. For the purpose of this comparison he had included the cost of electricity and steam as raw materials. Credits for by-products reduced these figures to 8.5d. and 7.8d. For the six selected stations to which he had referred in connection with the cost of coal, the cost of raw materials during last year had been 17.92d. per therm of gas made, and the net cost of materials after crediting by-products, had been 5.68d. per therm of gas made.

Operating expenses on conventional plant at Melbourne amounted to 6d. per therm and on the high pressure gasification plant to 3d. per therm. The comparable figures for the six English works had been 3.2d. per therm.

Plant Costs Higher

It would appear that costs for conventional gas plants in Australia were substantially higher than those to which we were accustomed in this country, and this same conclusion might have reasonably been applied to the figures forecast for the Lurgi gasification plant.

The further comparison between costs which took into account interest and depreciation was vitiated by the fact that the traditional gasworks costs were pre-war, and those for the new plant reflect all the inflation that had occurred since. Nevertheless, he found the estimate which is given of the capital charges at Morwell of 5.7d. per therm for the gasification plant plus long distance transmission were considerably in excess of those estimated in a preliminary study of the possibility of a Lurgi plant situated in the Midlands to deliver gas under pressure to London.

There were indications in the paper that many parts of the plant were designed on a much larger scale than the maximum for which the costs had been estimated, and it might be that some of the difference lay in this. He did not think anything here conflicted with their own conclusion that the comprehensive cost of gas manufacture by the Lurgi process, which included some considerable margin for distribution, was about the same as that for gas from conventional carbonisation plant operating under favourable conditions and that, of course, included a good coke market.

It was appreciated that this paper is a first account of a new and highly important project, and it was hoped that later it would be possible to give in greater detail particulars of the design, considerations and operational performance. Judged on the heavy expenditure on electricity, amounting to 2.2d. per therm, it had not been possible to take full advantage in designing the plant of all the possibilities of waste heat and power recovery. In a study they had made in this country they had found it necessary to lay out a plant to be as nearly self-supporting in power as possible, but there might be reasons why in Australia a different approach was desirable.

Gas purification was a matter to which they had given much thought, and the impossibility in Great Britain of extracting hydrogen sulphide by the water wash and blowing this gas to atmosphere had led them to look in other directions. It might be that the answer in the case of Morwell is that the coal contained only 0.19% of sulphur and the plant appeared to be situated in suitable isolation.

Mr. G. le B. Diamond, C.B.E. (Chairman, West Midlands Gas Board) said that he had noted that the oxygen used was of 95% purity, which was rather lower than the quality at Sasol and Dorsten. It was very well known that every additional 1% of nitrogen content decreased the calorific value of the gas by four B.Th.U. per cu.ft., so was there some reason why a higher purity of oxygen supply could not be attained?

Secondly, Dr. Andrews did not mention the type of oxygen compressing plant which had been installed, nor did he say anything of the protective devices. There had been at least one serious fire with oxygen compressors and the reports were that it had been a most alarming experience. Steel would burn like petrol. It was now generally thought that all electro protective devices should fail to safety in the event of loss of current. Moreover, in some cases, stainless steel lengths had been inserted as a fire break in the pipe runs for carrying oxygen to the gas production generators. He should like to know whether anything of the kind had been done at Morwell.

Purification Problem

He had been interested to see how the purification problem had been dealt with and he saw that Dr. Andrews had relied upon the straight water wash. One had to go back to the analysis of the coal to see why this should be effective. It was fortunate that the raw material had a very low sulphur content and, after the water wash, it was apparently possible to dealt with the trace of H_2S which remained after the water wash, by passing the gas through iron oxide. The problem of purification of high pressure gas had not entirely been solved in a manner which would meet the statutory requirements in this country. For example, while the water wash removed CO_2 down to 2% and the greater part of the H_2S, the released gases had a very high concentration of H_2S, probably of the order of over 700 grains per 100 cu.ft., which would have had to be purified by some means to satisfy the Alkali Works Inspector, apart altogether from the economics of sulphur recovery. The conventional low pressure oxide of iron boxes would have been used but the concentration was very high and it was by no means certain that oxide purification of the released gases could have been carried out economically.

As Dr. Andrews knew, to achieve synthesis purity it would have been necessary to install something in the nature of the Rectisol process which was working so well in South Africa. They had been very much attracted to it in the West Midlands because it would have resulted in a gas which would have been unique in quality and of immense value for industrial purposes. Unhappily, there were very serious snags with the Rectisol process for the CO_2 and H_2S were removed together and could not be readily separated. The H_2S would have either to be burnt to SO_2 or removed by the conventional oxide of iron purifiers which would have had the same disadvantage as he had previously mentioned. There remained the Alkazid and the Benfield processes, neither of which entirely met their needs. It would have been most interesting to hear from Dr. Andrews what considera-

tions they had had in mind when they had adopted the simple water wash process. The answer may well have been that the processes mentioned had not a state of development to warrant putting them in at the time the order had been given for Morwell. It would have been of interest to know what Dr. Andrews would instal now for purification.

Dr. Andrews was a little concerned about the calorific value of the final gas and wanted to find a satisfactory means of enriching it. Possibly, the brown coal tar, which was paraffinoid in nature, provided the answer. From the little information he had given it would have almost certainly produced a rich gas by catalytic cracking or, alternatively, by hydrogenation by the Gas Council's process which had been developed by Dr. Dent.

Complete Gasification

Dr. D. T. A. Townend, C.B.E. (B.C.U.R.A.), said that there have always been strong advocates of complete gasification in this country, but the problems had not been so straightforward, mainly because they had had to consider it in connection with bituminous coals, and therefore a much more thorough preliminary study had been necessary before any like venture could have been contemplated.

A most interesting feature of the paper was Dr. Andrews's consideration of the Lurgi process as a combined source of gas, liquid fuel and chemicals; indeed, at the pit-head, so to speak.

There were many features of Dr. Andrews's paper on which he could have dwelt if time had allowed; for example, the account of the distribution system and the problems which were involved in de-humidification in a pressure system and re-humidification on passage to a low pressure distributing system—these might not hitherto have impressed themselves upon the uninititaed. Also, the use of diethylene or triethylene glycol as a means of reducing the dew point of the gas was most interesting.

Another interesting point, he thought, related to the economics of using gas-fired super-heaters to heat the steam which was used in the gasification process. He asked whether this method lead to more steam being required to control clinkering, and if so, whether the cost of the additional steam, together with the cost of the gas used to fire the super-heater, outweighed any savings in oxygen cost. Information from other Lurgi installations indicated that steam consumption and decomposition had been improved by foregoing this superheat.

It was a little surprising that difficulty had been experienced with the ash removing gear in view of the low ash content of the fuel. He did not think that Dr. Andrews had commented on the character of the ash; he might have done so.

Dr. A. T. Green, O.B.E. (British Ceramic Research Association) said he would like to make a few comparisons of conditions at the two projects at Sasol and Morwell. At Morwell the problem had been mainly concerned with the washing out of brown coal. Sasol's problem had been high ash content of the Sigma mine coal. He had always considered complete gasification as an economic borderline case, yet a process essentially for low grade non-caking coals. Sasol had been economically based on coal fed to the gasifiers and power house with an ash content of 25% but in the early days this ash content had increased to, and had seemed to maintain itself at, 35 to 40%, which had virtually doubled the cost of synthesis per ton. It had been about this time that the economics of Sasol had been in doubt.

Secondly, Sasol, as at Morwell, had had great difficulty with ash removal from the gasifiers. At Sasol, quenched ash was water-borne through channels, pumps and 12-in. mains for about a quarter of a mile to the ash dumps and he could imagine the difficulties experienced if there should have been any hold-up in the channels and pipe line. He had often wondered, when he had been watching these blockages being cleared, what would happen when Sasol had eight gasifiers on stream, and the power house on full load. The whole of the ash from the power house and the gasifiers met in one stream and was taken away to the ash dumps. He thought that the 12-in. line was much too small and he could imagine the troubles experienced there.

Refering to ash troubles, he wondered whether Dr. Andrews could tell them if he had experienced any fusion of the ash to the rotating grate of the gasifiers.

Dr. Andrews did mention that ash troubles could have been corrected in one way by varying the steam/oxygen ratio. At Sasol, producing synthesis gas, little flexibility had been allowed with steam/oxygen ratio, and ash fusion troubles had been frequent. He had often thought that slagging producers might, in certain circumstances, have been a better proposition for synthesis gas production.

He would also like Dr. Andrews to tell them what happened to the gas liquor. Were phenols recovered, and the ammonia used? Sasol had been able to treat about 34,000 gal. of liquor an hour, with a liquor which contained about 1% of ammonia and 0.5% of phenols. Phenols had been recovered by the phenosolvan process, and the ammonia had gone to the production of 100 tons of ammonium sulphate per day. Morwell were considering ammonia synthesis for the production of urea. He asked whether Dr. Andrews could tell him whether the economics of nitrogen fertiliser production in Australia favoured urea against ammonium sulphate, or whether urea manufacture only became economic if CO_2 supplies were plentiful. The manufacture of urea was rather a new process for the gas industry and he had to point out that the economics of this process depended a great deal upon the design of the plant and the method of recovery of the excess ammonia.

The Brothers Woodall — Colin P.R.O., Radiation Ltd., and David, Assistant Commercial Manager (Sales), S.E.G.B.

THE CEREMONY OF SIGNING IN

Signing in on Tuesday morning. The predominance of the 'Financial Times' is explained by the distribution of copies at the hall. The issue contained a special gas industrial supplement.

WOODALL-DUCKHAM

DESIGN, BUILD AND SERVICE PLANTS FOR THE COAL, GAS AND STEEL INDUSTRIES

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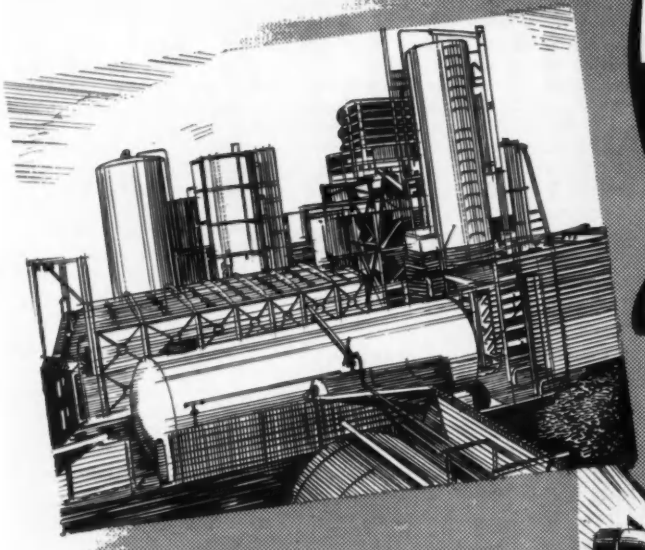

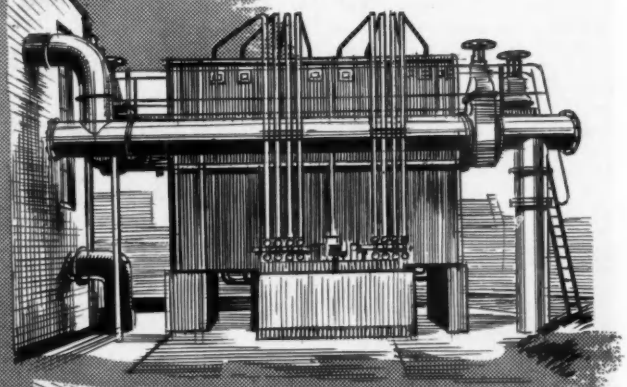

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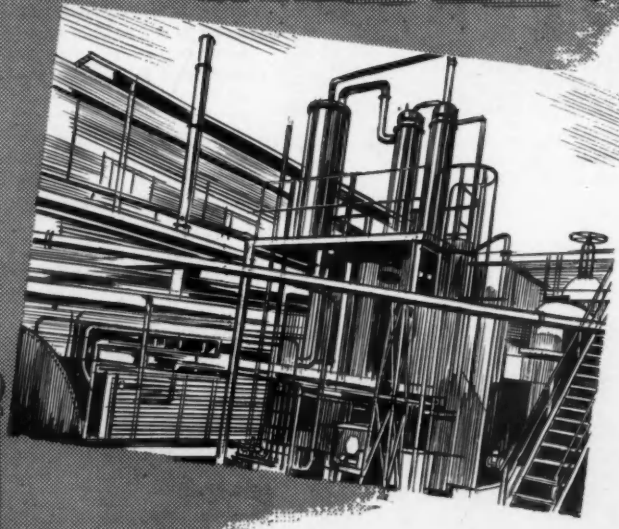

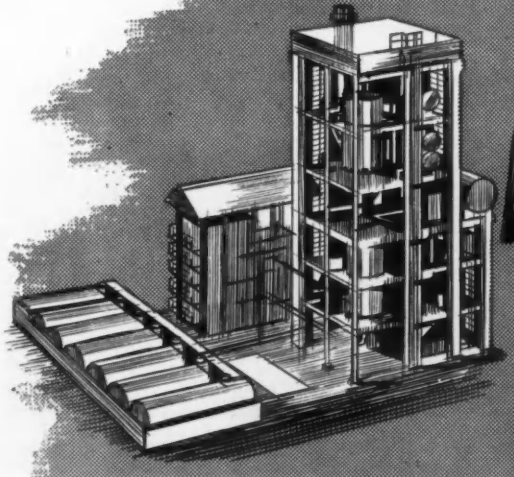

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Abstract of I.G.E. Communication 507

Meeting the Gas Load in the North West

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THE gas industry, unfortunately for the present-day consumer, did not enjoy the prosperous conditions of trading associated with selling its commodity at 'cost-plus' rates during the period from 1939 to 1949, but operated under a Board of Trade Order ('The Defence' (Gas Charges) Order, 1939) that virtually pegged the price of gas to the consumer. In so doing this Order placed restrictions upon gasworks' management.

During the period this gas industry in the North West met an increased gas demand of some 50% with little assistance from new production capacity. Severe shortage of materials and manpower placed drastic restrictions on renewals and extensions and, at the very time when everyone hoped for some relief in this direction, the industry in 1945 came face to face with the Government's declared intention to nationalise it.

On May 1, 1949, the North Western Gas Board took over and assumed control of the 103 production stations in its area. It also took control of 11,003 miles of mains, scattered throughout an area of 3,900 sq. miles, which, at that time were serving 1,685,356 consumers.

The size, type and, more particularly, the physical condition of the 103 works taken over varied considerably. Of the total production capacity of 285.22 mill. cu.ft. per day, 52.7% was continuous vertical retort capacity, 23.7% horizontal retort and intermittent vertical chamber capacity, and the remainder carburetted water gas. As a result, some works were in good fettle, but the majority were far from satisfactory and in a serious state of disrepair. The state of affairs is typified by a brief survey of the holder storage position in 1949. Out of a total of 285 holders (124 having been constructed before 1900) with a capacity of 206 mill. cu.ft., 30 were beyond repair and 66 in need of major repair. These 96 virtually derelict gasholders represented 29% of the area's storage potential. Similar shortcomings were met with in the distribution systems. Some had been well-maintained, but many had been underdesigned and were inadequate to cope with the peak demands placed upon them.

Management Structure

A management structure, based on 17 operational groups of unit undertakings, was designed to give a full measure of responsibility at district level under group chief officers directly responsible to the Board. Since 1949, these have been reduced to ten as a further move to improve management. A technical and planning division was set up at headquarters responsible to the Board for maintaining co-ordination of production and distribution activities in the groups, for providing a specialised technical service to the groups on any problem, and for providing and developing in co-operation with them a broad plan of technical development for the area as a whole. A full and detailed survey of the production sites and capacity was made, together with a long-term estimate of the probable demands for gas.

The pattern of the area was such that development could proceed along the lines only of major inter-linkage between stations across the broad industrial belt bounded by Liverpool in the West, Oldham/Stockport in the East, and with feeder lines within the Mid-Cheshire, Peak and Wirral districts. In the Northern district, local integration schemes based on Preston/Blackpool, Blackburn/Burnley, Lancaster and Barrow naturally emerged as independent patterns of development.

The future development of the plan may also be influenced by the availability of new processes for town gas production and the like. Processes producing gas at very high pressures can, for example, be accommodated by laying over the main arteries of the present grid a very high-pressure grid as the electricity industry is doing.

It is not proposed to inter-link the whole of the area physically, since in some cases it is not economic to bulk supply medium-sized demand areas remote from economically sized production potential. Nor is it always economic to site base-load production stations at the centre of gas demand, since other factors, such as coal price, coke marketing and service charges, may outweigh the advantages of short transmission.

Coke Out of Gear

It is not implied that incomplete integration will always apply, since the balance of the demand for solid and gaseous smokeless fuel will not, in the authors' opinion, remain constant. In the past, the demand for coke has been in and out of gear with that for gas, and thereby the stability of the industry's economy has been affected. The introduction of the Clean Air Act can, with good planning, keep the demand for coke and gas in gear for a time. In the long term, however, it is felt that coke will come out of gear again. With a progressive improvement in the standard of living, the authors believe that in 15 to 20 years' time the housewife's demand for solid smokeless fuel will almost have disappeared. Under these circumstances, complete integration may become a necessity since it is probable that changes in gas production technique and the advent of high-pressure gasification processes could economically accommodate such circumstances.

Since vesting date, the Board has been able to close down 47 uneconomic units and has enabled groups to afford bulk supplies of gas to the following districts so that the local overloaded station could be extended or receive a major repair without failing to meet an expanding load or immediate commitments—Bolton, Radcliffe, Salford, Rochdale, Fleetwood, Glossop, Hoylake, Birkenhead, Southport, and Manchester (Bradford Road).

The closures of small and uneconomic stations have effected substantial economies in the net cost of gas into holder at these sites, amounting in total to no less than £301,000 per annum, after meeting capital charges and compression costs applicable to the individual supply system. They have, of course, enabled these stations to accept substantial additional loads without the necessity of embarking on major extensions to their plant, involving, in the majority of cases, the construction on new sites of uneconomically sized production units. Middlewich provides a typical example. Here the output has increased to 3.9 times the previous maximum capacity of the old station. At Northwich, the output is now 1.5 times greater.

The integration systems so far completed in the area are now so much a part of the day-to-day operation of many of the Board's production stations that it is difficult to segregate the advantages of their availability from the overall improvements achieved in the general production results. In presenting

economies achieved at the present stage of development it is better, also, to indicate the area position as a whole rather than attempt to segregate individual sections.

Since vesting date, the North Western Gas Board has spent £28,794,048 on the renewal of existing and the provision of new and additional production units. Renewals account for some £8,151,595. The return from capital expenditure on production plant, grid mains and additional storage, together with better management, can best be appreciated by looking back at the production results of the area and the productivity of the labour force engaged on these duties during the year 1949-50. Production results year by year since vesting date show clearly how great has been the improvement in thermal efficiency over the period to March 31, 1956.

The closure of the small and largely manually operated stations, the base-loading of other stations, and the improved plant production capacity in the area have had material effect on the productivity of labour. In a graph of the man days worked per 1,000 therms of gas produced since vesting date, it is shown that since the end of 1950 there has been a progressive increase in the productivity of shift labour engaged on gas production. Man days per 1,000 therms fell from 2.9 in 1950 to a current figure of 2.1.

Abnormal Maintenance

The total labour on production has been affected by abnormal maintenance and works clearance programmes. These, however, are now showing a substantial improvement and the total man days per 1,000 therms has fallen from 7.56 to 6.4. With plant now able to maintain optimum output, and by being able to base-load it and use plant capacity previously idle due to lack of local demand, the available production capacity has materially improved to an extent equal to 38.865 mill. cu.ft. per day, after taking into account new production plant, obsolete plant scrapped and works closed down.

At the end of 1956, there remained throughout the area 57 production stations, 32 of which were connected to the main grid system. These 32 stations do, however, produce approximately 80% of the total gas made in the area.

Internal group control associated with some small measure of inter-group working had functioned admirably since vesting date, and accounted for vast economies, but physical integration of production stations had advanced so much that it was essential to establish procedure to permit maximum inter-group production and distribution activities.

Early in 1956, therefore, two main control sections were established so that gas-production programmes within those groups and the interchange of gas between them and works on the main grid could be planned in advance, and later implemented on a weekly and daily basis. Any forward plans, at whatever level they are made, can, in the first place, only be based upon estimates consequently, while a forward plan can be agreed in principle at section level, it can only be carried out day-by-day in detail if all departures from estimates are made known to the appropriate section, and then to a central grid controller responsible for co-ordination between the two control sections. A central grid controller was therefore located in a control-room and an area information centre established at the Technical and Planning Division of the Board.

Only seven of the Board's 70 groups are at the moment inter-linked. These are the Central Lancashire, Liverpool, Manchester, Mid-Cheshire, North Cheshire, South Lancashire, and Wirral groups. The grid between these seven groups is to be broken down into an eastern and western section, each with a co-ordinating committee, and the deliberations of these two committees are to be still further co-ordinated as necessary by an area committee made up of the convener of the section committee and the Board's Production Engineer acting as convener of the area committee. The Technical and Planning Division of the Board is to be represented at all section committee meetings by its grid controller to ensure liaison, and representatives will additionally attend area committee meetings.

If for any good reason a member is not able to attend a committee meeting, his place is to be taken by his deputy, but if no official deputy exists, the group engineer concerned is to be represented by someone nominated by the Chief Technical and Planning Officer of the Board.

The Committee's terms of reference will be:

(1) To ensure that there is at all times enough gas available for distribution to meet the demands of the main grid area in full, and with the calorific value, hydrogen sulphide content, etc., that the Board is required to produce under the terms of the Gas Act, 1948.

(2) Notwithstanding the committee's obligation under (1), any production programme laid down to achieve the aims set out in (1) must also have regard to production costs, and these should be considered in the light of what is the most economic programme for the area as a whole.

(3) When planning a programme that meets the requirements of (1) and (2) the following must be taken into account:—

(*a*) Availability and price at the place of usage, of coal, oil, and coke.

(*b*) Availability of plant, having regard to its condition and the timing of repairs to it and other plant.

(4) To consider coal quality in relation to availability and the type of plant it is at the time used on, and to make any necessary recommendations for replacement of certain coals by others, or for their re-direction to more suitable plants.

(5) To plan repairs and major reconstruction of all classes of plant associated with production, so that they may be caried out efficiently and with the minimum adverse effect on area costs, and to keep the Board's Constructional and Maintenance Engineer informed of such repair programmes.

(6) To report each year not later than the middle of January, to the Board's Chief Technical and Planning Officer, on the relative position of available production capacity to demand week by week for the 12 months to follow, and to give a further report covering a four-year period. This, however, need only relate available daily production capacity to the average day of the anticipated maximum week.

(7) To prepare, at the same time as the report referred to under (6), a production programme for each works, showing how much gas each works is expected to produce each week for the ensuing 12 months, and further indicate the combination of types of gas that are to make up the the total, i.e., continuous vertical retort gas, intermittent vertical chamber gas, horizontal retort gas, producer gas, blue water gas, or carburetted water gas. It will, of course, be necessary to revise such programmes from time to time at the monthly meetings, to cover delays on repairs, variation in load, etc.

(8) To arrange with the group distribution engineers the bulk movement of gas that will be necessary to make effective any production programme.

(9) To liaise with group general managers and their other officers, so that, at all times, the maximum time is available to plan for increases or reductions in demand.

The central control-room is situated at the headquarters of the technical and planning division. Three main responsibilities are undertaken here:

(1) Responsibility for co-ordinating forward plans and day-to-day policy of production and distribution. In particular to ensure that load is met by the most economical means for the area, irrespective of the internal economies of any of the groups concerned.

(2) Responsibility for arrangements necessarily arising out of contingencies such as mechanical breakdown, etc., in order to restore the position as quickly and economically as possible.

(3) Responsibility for providing information on production and distribution activities throughout the system to all groups on the grid.

The two section control-rooms operate on a 24-hour-per-day basis, and receive information every three hours about holder stocks, gas makes, and gas sales from either individual works or sub-control centres of the grid system. From this information, it is possible for the day-to-day policy to be fixed via headquarters control, and more especially to direct the appropriate emergency action, if this arises, at any point within the grid system itself.

The eastern section operates 19 production stations having a total capacity of 162 mill. cu.ft. per day, and 106 gasholders with a capacity of 105 mill cu.ft. The western section operates 13 production stations with a capacity of 128 mill. cu.ft. per day. In this section are 62 gasholders with a capacity of 62 mill. cu.ft. per day.

The eastern and western sections combined produce 80% of the Board's gas, and every 0.1d. per therm reduction in

manufacturing or distribution costs achieved represents a saving of £140,000 per annum.

Directions in which savings may be achieved are—reduction to the minimum of the 'standing hot' time on carbonising plant; reduction to the minimum of the quantity of carburetted water gas produced to meet any given gas load (since the western section has, of necessity, to produce a base-load quantity of carburetted water gas, the policy at all times is to pass into the western section as much surplus coal gas as is available from the eastern section); and reduction to as few units as possible of load variations on production plant.

The main grid is confined to seven groups, as previously stated, and the remaining three groups are gridded either wholly or partially within themselves. All the grid mains concerned, while fulfilling their prime functions of providing bulk or topping up supplies between the various works and holder stations within and between groups, also play an important part in district reinforcement schemes.

In 1956-57, 141,833,134 therms of gas (nearly 40% of all the gas produced in that year) were distributed by the main and internal group grids; 75% of that amount was for total or partial bulk supplies, the remaining 25% being for district reinforcement schemes. The overall cost of the bulk distribution of gas was 0.96d. per therm. Long-distance transmission between the two main control sections (i.e., Manchester and Liverpool) cost more than the area average figure, of course, but this is compensated for by lower pressure and shorter-distance transmission within those sections and within those four groups not on the main grid.

Since vesting date when not more than two or three undertakings of the 103 could honestly say that their systems were operating within the 6 in. to 4 in. W.G. range, detailed surveys have been made of all low-pressure systems in the area. As a result, low-pressure systems at 26 undertakings have been completely reconstructed, and it can now be claimed that only a dozen or so systems are left that are not up to the desired standard. The standard is that the consumer shall be able to get all the gas he needs when he needs it. Almost 200,000 new houses have been provided with a gas supply since vesting date at a cost of £4,639,500. The extra cost on this expenditure to distribution charges has been 0.2d. per therm. It is interesting to note that the cost of providing gas to housing estates has risen from approximately £19 to £26, or 37%, per house. Of this, the cost of services has increased by 78%. This would have been much greater had the Board not, during 1952, changed from the dual- to the single-service mains system.

Records indicated that at vesting date the Board had 1,685,356 services, and at March 31, 1956, this figure was 1,819,613. During the period, some 226,000 services have been renewed at an average cost of £6 18s., and a further 710,000 have been cleared of internal deposits. The progressive growth of the cost of providing an efficient distribution system is clearly shown by its rise from 0.53d. per therm, in 1950, to 1.01d. per them in 1956. In the same period, the capital costs of gasholders have increased by some 75% and of compression plant by about 80%. Everything will continue to be done to keep the cost of an efficient distribution service to a minimum. The value of the Board's stocks of pipes is an example; in spite of increased costs, the stocks at March 31, 1956, stood at £450,000, compared with £585,000 near vesting date.

In 1952 the total staff on distribution work amounted to 2,711. By March 31, 1956, the number had been reduced to 2,364.

The authors believe that the North Western Board in meeting the load by the methods outlined in this paper has progressed well along the road to optimum productivity; no-one but a fool would ever allow himself to believe that such a road had an end, and the Board will continue to travel along it, but at a reduced rate. The rate of expansion is reducing, and such expansion as there is, is in the industrial field, i.e., low-priced gas.

In spite of increased yields from a ton of coal which have helped to prevent the net cost of coal rising in direct relationship to the cost of coal, and further assistance from better utilisation of labour, the Board's growth is now almost static. The authors can reach no other conclusion than that the present methods of providing a 'heat-on-tap' service are too dear. The Board is being priced out by its competitors and must look for new methods. These, the authors believe, are to be found in the complete gasification of coal at high pressure, accompanied by a measure of oil gasification and other possible side processes.

DISCUSSION

Mr. T. S. Ricketts (Chief Engineer, Scottish Gas Board): 'Any paper which emanates from the North Western Gas Board deserves particular attention and the paper which has been presented today, as its name implies, is of outstanding interest and importance to the gas industry. It is a description of the progress of the development plan adopted at vesting date by one of the largest gas boards in the country and it may be considered a success story in so far as all the aims as set out on page 8 of the paper have been achieved or are within sight of achievement. The description of the dilapidated condition of some of the plant taken over in 1949 is, unhappily, only too familiar, being typical of conditions within many area boards at vesting date, but the authors have put forward a fair and reasoned explanation of some of the factors which may have caused this unsatisfactory state of affairs.

'The progress of integration in the north-west has now reached the stage where 32 works are supplying the main grid with more than 80% of all the gas sold in the Board's area, and the size of the average works by calculation from figures contained in the paper appears to approximate to 9 to 10 mill. cu.ft. per day. Whether or not this is the optimum size for a works is not stated, and perhaps the authors would say whether it is the intention to further reduce the number of works with a consequent increase in individual size.

'The central grid control system which has been set up makes use of the committee system, and with seven groups being supplied by the grid this decision is understandable. There has already been a reduction in the number of groups in the area from 17 to 10, and it may be that with the completion of integration this number could in due course be further reduced.

'There are only two ways in which a large grid system can operate: One is by complete functional control whereby all production processes and personnel are responsible directly to grid headquarters; the other way is by the liaison method of control allied to the committee system with appropriate terms of reference. Speaking from experience of grid control and operation in another board, I think the method adopted in the north-west is the correct one under existing conditions. Whichever method is adopted it is essential to ensure that at all times the grid controller possesses the necessary authority to meet his responsibilities. It may be found expedient in due course to form one committee only to deal with the grid, for the area covered is not unduly large, covering an area approximately 50 miles by 60 miles.

'A description of the method of costing within the grid would have been of interest. For instance, is grid capital expenditure considered to cover new gasholders and new peak load plant required specifically for grid operational purposes, or is this expenditure borne by individual groups? When certain groups are required to manufacture excessive volumes of expensive peak load gas or to work at a poor load factor for the benefit of the grid as a whole, are the extra costs borne by the grid or the groups concerned?

'The success of a development plan lies in the technical and economic results achieved. In the north-west all the technical aims appear to have been achieved. The thermal efficiency of production has increased from 71% in 1950 to 77% in 1954, but it appears to have stabilised since that date. Man-days worked per 1,000 therms of gas have fallen from 7.5 in 1950 to 6.2 in 1956 and appear to have levelled off at this figure.

'But the economics of the plan have been affected, as always, by rising costs and the progress of competitive fuels, and the authors reveal their concern at this for they point out in the paper that it no longer appears possible to meet increasing costs in the future by means of increased process efficiencies. Herein lies the real reason for the anxiety which they rightly express concerning the future of the gas industry, not only in the north-west but also throughout Britain.

'Since vesting date the capital expenditure on new production plant in the north-west has amounted to more than £20 mill. Capital expenditure of similar magnitude has taken place in other area boards. We cannot continue capital expenditure on this scale unless we are quite certain that the production process in future will be economic.

'It is evident that the authors believe the gas industry must adopt new processes if it is to survive. They are not alone in this belief. Perhaps because it makes use of a home-produced fuel the gasification of non-caking coal under conditions of high pressure deserves particular attention, and I may be excused if at this stage I mention the possibility of complete gasification plant in Scotland.

Integration in Scotland

'Integration has proceeded more slowly in Scotland than elsewhere but a study of the position indicates that 55 to 60 small inefficient works can be closed down during the next five years. The opportunity thus presented for the development of grid systems is associated with the need to plan new production units, and it is vital for us to make the right decision concerning our long-term production plant. The possibility of complete gasification of the low rank poorly caking coal which is to be found in considerable quantities in Scotland is very attractive and we may find that we are in a favourable position by virtue of the location of the coalfields.

'No coke is produced by a plant of this kind, neither is it produced by an oil gas plant or by the importation of liquid methane. The authors state that they believe that the housewives' demand for solid smokeless fuel will have disappeared in 15 to 20 years' time and one wonders how this opinion agrees with the thoughts expressed in the coke symposium a year or so ago. It can be considered excusable, perhaps, if a slight feeling of bewilderment exists; should we increase the production of coke from existing plants in order to meet a demand that will vanish in a few years' time? Should we arrange to prepare a special fuel for the domestic market when the economic plants of the future may be those which produce no coke?

'These are difficult questions but I believe it may not be a bad thing to find ourselves confronted with this variety of possibilities. We appear to have reached the end of a chapter in the long history of the gas industry and the new chapter which is about to commence will demand a freshness of thought and a completely new approach if we are to seize the opportunities which may be presented to us.'

Mr. Eric O. Rose (Divisional Engineer, Tottenham Division, Eastern Gas Board): 'The extent of the reorganisation carried out in the area of the North Western Board since vesting date is considerable. Owing to the high percentage of municipal undertakings there had been little previous amalgamation and in so far as integration was concerned the area was considerably behind other parts of the country. We in the South of England should realise this and, if I can draw a parallel with the London area, it is as if we had been faced, at vesting, with a gasworks in every borough. It would not have been a situation any of us would have liked.

'In dealing with co-ordination of this kind it is not difficult to determine which undertakings should be closed down. The main problem is to find the replacement gas without undue capital expenditure, and to maintain outputs at those works already doomed, until the necessary extended plant is available elsewhere. The authors have clearly indicated how, by improved efficiency and load sharing, the supply has been maintained.

'It is surprising what increases can be obtained by proper planning and management when by the proper use of interconnecting mains, so-called standby plant can be put into full use. I can call to mind an example, in my own experience, of a pre-war amalgamation in which an undertaking sold out because the directors considered that a maximum daily load in excess of 2¼ mill. cu.ft. per day could not be met without further extensions. Within a very short time, under new management, twice this output was being maintained, for prolonged periods, with no additions in plant.

Central Control

'I am very interested in the section dealing with central control. The type of planning set out is, of course, that which has to be undertaken by anyone operating a co-ordinated system of manufacture. I note, however, that the reference to the committees is set in the future tense. The structure seems a little elaborate and one's natural preference would be for a committee of one—the production engineer. It can be understood, however, that in the north-west the number of undertakings is so large, and the interchange of gas often only marginal, that one man could not be expected to keep himself informed of the day-to-day position in every works, and that it is necessary to divide the area into two regions.

'In my own Division, admittedly with a smaller problem, we established an engineering costs and records department many years ago. This records all matters on manufacture on a daily, weekly, monthly and annual basis. This department adjoins the central control where hourly production figures are available. With an efficient costs and records department at his elbow the production engineer can have all the lengthy calculations required for proper load planning quickly turned out for him on calculating machines.

'To reach correct decisions in load planning it is always necessary to consider a number of variables, and one is always looking for short cuts. My own view is that now that casual labour has ceased to exist and every works is on a fixed establishment, the usual calculations on a cost per therm basis cease to be valid. The first operation is to determine the possible peak demand and fix what plant is to be kept in service to meet that demand. Sufficient labour to man that plant must then be employed all the year round. Labour costs therefore become a fixed annual charge and can be largely eliminated from week to week load planning calculations. The matter then comes down to the much simpler basis of net cost of materials, and we are back where we started 100 years ago.

'Standing Hot' Costs

'Reference has been made to "standing hot" costs. In the south where oil is relatively cheap we do not "stand" retorts but balance our load with water gas. Care has to be taken, however, that money is not wasted by carbonising plant being allowed to fall short of rated output, even by a few per cent., for quite unimportant reasons. It is easy for any individual works to make up a daily short-fall by added water gas. Any system of control must, therefore, see that planned outputs are maintained. My own ideal is to perfect the system of production records to such a state that in the ultimate, the results for each plant are reduced to two simple figures. First, a production efficiency, which is the actual output divided by the planned output, and second, a thermal efficiency, which is the actual thermal efficiency divided by the standard thermal efficiency. If every carbonising plant can show 100% for both these figures, all is well.

'The sting of the paper is in the tail. Broadly speaking, the authors are of the opinion that the lowering of production costs, in existing processes, has been carried as far as possible, and that sales expansion has gone as far as the present price of gas will allow. The curves are flattening out and the law of diminishing returns is beginning to operate. This is the challenge of the paper. I would agree with the first suggestion, but not necessarily with the second.

'As to processes, there is, of course, a great difference in the cost of coal between the north and the south. In the north the natural answer is complete gasification of one form or another in very large units. In the south we have looked to oil. Suez has certainly set us back, but the developments taking place in most of the Boards in the South of England indicate that a very much cheaper therm could be made from one oil product or another and in one way or another.

'Whichever way our choice lies, however, we have one main problem, namely, capital cost. If we embark on new processes, what about the money we have already sunk in straightening up the old ones? Our present financial structure demands that this capital is written off, on the average, over some 35 years. On the face of it, it cannot be written off in less time without serious damage to the price of gas. In 35 years' time, will our successors want to be operating the plant we are building now? I sincerely hope not.

'Our present capital expenditure can only be written off earlier in two ways—inflation and expansion of output. Infla-

tion we shall get, without asking for it. I do not want to encroach on one of tomorrow's papers, but I put it to you that inflation is the natural corollary of a state of healthy progress and is the one means by which obsolete plant can be got rid of cheaply.

'Expansion of output we must also have. The authors seem a little pessimistic. In the South of England at least gas is not too expensive for cooking, nor for water heating, nor for many industrial purposes. In the great potential field of space heating, however, we seem to have made little headway and this in spite of the fact that the price of gas per therm on a two-part tariff is only about 1.9 times that of solid fuels. Considering all the inconvenience of solid fuels, we may well ask ourselves why we do not do better. The simple answer is that all over the country there are people trying to keep themselves warm with gas fires operating at an efficiency of some 40%—and this while the North Western Gas Board is producing gas at a thermal efficiency approaching 80%. All the toil, sweat and tears of engineers to gain another ½% in efficiency is of little avail if the efficiency of utilisation is low. It is this latter which determines the real price of gas. Solid fuels can be burnt domestically at 75% efficiency. Cannot we do the same for gas? I do not, of course, mean flueless heating and living in an atmosphere of CO_2 and water vapour.

'Salesmen of late have developed the habit of telling engineers what they will or will not have in the way of gas quality and they complain that our production price is too high. It is now time for a return match. We want gas appliances suitable for whole house heating, at reasonable cost and burning at 75 to 80% efficiency. Then, and only then, shall we sell more gas per consumer, reduce our distribution costs per consumer and pay for the establishment of our new processes.'

Coke Oven Complex

Mr. W. A. P. Hoskin (Barnsley): 'Naturally, you would expect any remarks of mine to be coloured by the coke oven complex, and it is rather a coincidence that the two main problems tackled by Mr. Hodkinson have had a coke oven plant in one place or another in the base load unit. I am referring to the one in Yorkshire at Hemsworth and the one in Lancashire at Altham.

'This is not a plea for the coke oven. The coke oven has long since proved itself in London, Yorkshire, South Wales and the north-east as the ideal unit for base load, and Mr. Pyper ably presented the case some three or four years ago. What I wish to do is to relate this paper to that given by Mr. Johnson yesterday afternoon. Criticism was made then of the difficulty facing the gas industry by the failure of the National Coal Board to bring the ash and moisture content in the coal down to a "satisfactory" level, although "satisfactory" was not itself defined, and also to provide suitable graded coal to suit the requirements of the gas industry. I was reminded by a prominent member of the gas industry after yesterday's meeting of a remark attributed to me at a previous Institution meeting when I was allowed to contribute to the discussion. I was reminded that I said that in the coke oven industry the problem was not that of producing gas from coal, but of producing it from a mixture of water and muck.

'My point is this. The coal industry has an increasing problem of producing enough graded coal for the gas industry, yet the quantity of smalls is increasing—according to Mr. Roberts the ratio is 21:44. The coke oven will handle the smaller coals very satisfactorily and produce a gas of consistent calorific value. Therefore it would be interesting to learn from the authors of the paper of any consideration which might have been given to the use of the coke oven for base load production in an area adjacent to the Yorkshire and Lancashire coalfields. It would appear that the authors rather favour the use of the coke oven to be integrated with electricity production rather than use the gas so produced as a base load for their own industry. The authors might reflect that the cost of gas from a coke oven is rather low. By so doing it suggests the desire of the gas industry to revert to the policy of a one-fuel industry and so sustain the authors' belief that in 20 years' time there will be no demand from the housewife for a solid smokeless fuel.

Comparison with Birmingham

Mr. H. Moys (Birmingham): 'I notice that the main grid connects 32 production stations that in turn make 80% of the Board's gas. In the North West the main works are concentrated in the Manchester and Liverpool districts with the larger consuming area nearer to the former. In the West Midlands, Birmingham forms the hub of our central area, in which nearly 77% of our gas is made in works which originally totalled 31, but which have been reduced to 23.

'We have been less rapid in the integration of undertakings and it is unfortunate for us that the cost of materials should have continued to rise steadily, but even so the undertakings in Warwickshire and the Black Country are linked and integration has taken place around Worcester, Redditch, Wellington and Stoke. Whether the linking up of all undertakings as practised in the North West in the Liverpool and Manchester area is justified in our area I should doubt.

'The six main aims listed in the paper form a very satisfactory basis for founding a development plan. I think that the North West are perhaps fortunate in having in their possession sites that provide the necessary flexibility when the emphasis to-day may be on oil importation, tomorrow on coal carbonisation and the day after on coke exports. Works at Liverpool and Manchester seem to have this much envied flexibility especially when in one case at least there is also the possibility of taking tail gas from a nearby refinery.

'The layout of the integration system is discussed and it would appear to me either to give an optimistic impression of far-seeing design or else to be over-designed to cater for handling the considerable volumes of gas that would be made available by (1) complete gasification plants which are indeed difficult to site, (2) pit-head carbonisation, or (3) discovery of natural gas. In our area we visualise that a number of special H.P. feeder mains will supply the principal and subsidiary networks with Lurgi gas.

'The facility to use integration mains that enable substantial loads to be added is worth underlining. I notice nowhere in the paper any reference to supplies to villages or hamlets that are traversed by integration mains and one wonders if the North Western Gas Board has been able to introduce gas to villages that had never had gas or in which the production and distribution of gas had ceased before 1949.

Chart on Manpower

'The chart on manpower is most interesting and would be more helpful if the descriptions of those persons included in the various categories were given so that each one of us could make comparisons. The importance of increasing productivity per employee is now being sufficiently realised and, in our Board, work study and organisation and methods officers are doing most useful work.

'I am particularly interested in the section dealing with the control of production and distribution as we are, at the moment, engaged in setting up a similar control for our central area. It is not clear to me who is held responsible by the Board for the carrying out of the item (1) of the terms of reference. I suggest that a committee cannot take that responsibility but can only help with all the advice possible some person so charged. I can understand that from the main committee the east and west conveners depart with instructions that they pass on to their sub-committees. Since these are instructions, are the group and local engineers' responsibility for efficiency and costs lessened? Any methods that the authors have developed to deal with these matters would be most welcome.

'Do the authors insist on the metering of gas transferred between groups or districts, and what has been the effect of integration on the "unaccounted for" gas? How do the authors follow recommendation No. 34 of the Ridley Committee that "prices charged by Gas Boards should reflect local differences in costs of supply"?

'I notice that daily production capacity is related to the average day of the anticipated maximum week. Perhaps with the lower industrial load in the north-west the incidence of the five-day week is less acute than with us, but I should be interested to know what percentage of the maximum day's sales can, in fact, be made. I cannot fully understand the function of the central control room. As an information and planning centre it is excellent, but since it operates on a daytime basis it is difficult to see its use as a control. What information does it receive daily, and what decisions can it make? When planning plant capacity to be available, is any use made of

meteorological information about the likely temperature to be experienced in any week? '

Mr. L. J. Clark (Development Engineer, North Thames Gas Board): 'The paper is full of many facts and figures and, of course, one is tempted to ask numbers of questions. I should like, however, to confine my comments to three points. First, I would refer to Table 3 of the paper concerning the therms of gas produced per ton of coal carbonised. These figures do show a very marked improvement over the years. I should like to ask the authors if they would indicate the calorific value to which these thermal yields refer and whether there has in fact been any change, or changes in the average calorific value, in the area over that period.

Question of Labour

'Comparison of these figures from one area to another is always difficult because they are usually on a different basis. When we come to the question of labour at the various stations and the very great improvement which has been shown in the north-west there is one point which does surprise me. It may be that I am not reading the graph correctly but there does not appear to be a very marked difference in the man-days required in summer and in winter. Is that an indication that the effect of the peak load in the north-west is less severe, or very much less severe, than in the south? For instance, we find that our labour requirements of man-days worked per 1,000 therms produced varies from something like five in the winter months to about eight in the summer and, of course, that means that gas production men are transferred from the gas-making plant in the summer period to do other jobs. The figures for the north-west do not reveal any marked effect and I wonder if there is any averaging effect.

'Another point which arises in connection with these figures is that I believe it is the practice in the north-west to use contractors very considerably for maintenance work and I should like to know whether that has been taken into account in these figures.

'Finally, referring to the control room, I should be pleased to have further information on the methods of forecasting the gas requirements ahead, on the maintenance programme for carbonising and whether gas plant is determined in relation to a programme of gas requirements? Is it determined by temperature or purely from past experience? I think that additional information on those points would be very helpful to us.

'This is indeed a very fine story and I think that whatever happens to our industry in the next 20 years posterity can look back on this particular period of the first seven years after nationalisation and feel that during that time our stewardship has at least in part been satisfactory.'

Mr. F. Litler, in reply: 'Most of the points we should prefer to deal with in writing but there are one or two which I should like to deal with now. I think both Mr. Ricketts and Mr. Rose made some comments regarding the method we have adopted in the north-west for controlling the integrated system. They felt that it was too elaborate. We have one fundamental principle in the north-west and that is that we like to be democratic. We like all our people in our organisation to know what is being done; we like to keep them in the picture rather than have a dictator being responsible for deciding how 80% of our gas is being made. Therefore we have these two committees because each of our groups, and there are seven of them, have to produce at the end of each year a set of accounts and they have to be responsible for their financial operations. We therefore cannot have one man in management telling the production engineer how to make his gas. The engineer must have some say in the matter. You have to have him with you if what is being planned is to be in the interests of the area. There is no doubt at all in our minds that this is the most successful way of operating these methods of control—it is democratic rather than any form of dictatorship.

Size of Works

'Mr. Ricketts mentioned the size of works. At vesting date the average size of our works was 4 to 5 mill. cu.ft. Today the size is about 9 to 10 mill. cu.ft. We do plan, as long as we have to stick to traditional methods of carbonisation, to cut down ultimately to 45 production stations and they will be larger than today but we do not visualise very large ones—30 to 35 mill. cu.ft. on present production technique.

'One speaker suggested that the number of groups should be reduced from 17 to 10. I think I can say that for the time being, and for some considerable time, that will not be done.

'I think Mr. Ricketts asked about capital expenditure on the grid. What is referred to in the paper as capital grid is restricted to mains, station equipment and to compression plant. Gasholders are left as a general distribution charge although we feel that they are essentially a function of production and should be charged to production except in one or two isolated cases where a gasholder is playing a dual role.

'Another point raised was with regard to the production of smokeless fuel which we think we shall increase over the next 20 years and that it will then fall away. The question was, what is going to happen to the capital? We feel in the north-west that it is possible to increase production by adopting a carry gas system without increasing capital. We can assist in providing local authorities with smokeless fuel at a relatively low capital outlay. It fits into the picture where in 10 to 15 years' time new methods of manufacture are coming along which are going to reduce the price of gas considerably.

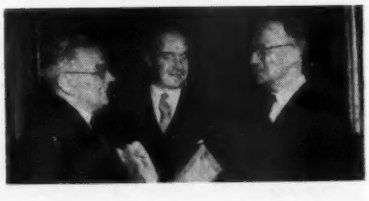
'Another point is the capital aspect of changing over from one method of production to another. We have said that no new method of gas manufacture should be adopted unless it makes a considerable reduction in the price of gas to the consumer to enable us to expand. What the industry needs is expansion. We must have it if we are going to succeed and therefore we must have a considerable reduction in the cost of producing gas and accelerate our rate of depreciation on our capital.

'Mr. Rose raised a very interesting point about increasing the efficiency of gas appliances. Of course, I am 100% with him but I do feel with regard to appliances that not only lack of efficiency in utilisation but also the cost of these appliances is a difficulty. Such attempts as have been made on space heating equipment to improve efficiency have always resulted in an increase in price of 75 to 100% and people cannot afford to pay £40 or £45 for a very efficient gas fire. We want an efficient appliance which is nevertheless cheap. I think some headway could be made if only the basic parts of gas appliances could be standardised so that they could be mass produced. Any variation required could be made on the cheaper outer casing. It is only by standardisation and mass production that these things will ever come down to a reasonable price. Too many people are making these things, all different one from the other.

'Another point raised was the question of who is responsible for making a final decision about availability of plant to meet the gas load. Really, the board are the people finally responsible but the chief technical officer is the man ultimately responsible to the board. At the meetings of the two committees they know the load they have and what plant they have and they put forward a plan of production and the technical officer is free to accept it, modify it or reject it.

'Finally, the question was asked as to what percentage of the maximum day we were actually able to make. That figure is 91% and if it is a heyday we can make 97%. I think it was an average day.'

Mr. Litler said he would reply to the rest of the questions in writing.



Mr. Tom Cameron, of Coleraine (centre) with Mr. Robert Miller and Mr. Kenneth Clark, both of W. J. Jenkins & Co., Ltd.

Mr. A. H. Barrington (Stretford), Mr. T. Biddulph Smith (Partington), and Mr. N. F. Riches (Denton).

Our Camera at the Meeting

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East Midlands conversation piece. Mr. E. H. Harman, Secretary, Mr. R. S. Johnson, Chairman, and Mr. Bernard Clarke, Lincolnshire Divisional General Manager.

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Mr. J. E. Davis, Chief Technical Officer of the South Eastern Gas Board, Mr. J. A. Prigg, Watson House, and Mr. D. Scott-Wilson, Gas Council.

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Dr. A. E. Haffner, Chief Engineer, Southern Gas Board, Mr. G. Dougill, Planning Engineer, North Thames Gas Board, Mr. E. Coates and Mr. T. H. Riley, both of Power-Gas Corporation, Ltd.

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Mr. Sam Hall, Thomas Glover & Co., Ltd., Mr. F. G. Symon, Production Engineer, Oxford and Reading Region, Southern Gas Board, Mr. A. McDonald, Member, and Dr. R. S. Edwards, Chairman of the North Eastern Gas Board.

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President's Luncheon

Sir Henry Attacks Unfair Competition

and Christens the 'Fuel Master General'

MR. REGINALD MAUDLING, the Paymaster-General, acquired a new title when the President's Lunch was held at the Savoy Hotel on May 14. Sir Henry Jones suggested that he should be called 'Her Majesty's Fuel Master General' in recognition of the way in which he had restored the industry's confidence after their misgivings concerning the omission of the word 'fuel' from the Minister of Power's designation. Sir Henry was responding to the toast of 'The Institution of Gas Engineers,' proposed by the Paymaster-General.

Mr. Maudling said that he had learnt two particular things about the gas industry from the President's Address. The first was the persistence of family ties and family connections which was particularly exemplified by the President himself. That was an extraordinarily satisfactory thing to see in the development of any industry. Secondly, it seemed clear that the position of the engineer in the gas industry was a very high one indeed, and it was interesting to learn of the very large proportion of the management of the industry which was conducted by engineers.

The one thing he had learned at the Ministry of Supply was that the future of this country in the economic sense depended entirely on the co-operation of our scientists and our engineers, and that the one was quite useless without the other. The gas industry, like all our power industries, was facing a difficult but an exciting future. The whole problem of meeting the nation's requirements for energy was one of great complexity, and it was quite clear that if our national production expanded at anything like the rate they hoped for over the next decade or two, increasing quantities of energy from all the primary and secondary sources would be required. It was a competitive world, but it was a world in which there was competition for a rapidly growing amount of business.

Changed Pattern

Apart from the question of the total energy requirement of the country, however, a very considerable change was taking place in the pattern of those requirements and in the pattern of the production of energy. He believed that an industry like the gas industry would be able to succeed in making its way forward in these changing circumstances by reason both of its traditions and by reason of the very considerable amount of research and development work that was being done.

One of the main changes in the field of energy requirements was that they would be getting less large coal. Despite the efforts of the National Coal Board, the percentage of large coal mined was falling steadily year by year and was almost certain to go on falling. The demand for small coals would be replaced to an increasing extent in the future by the advent of nuclear power. On the other hand, the demand for carbonisation coals was bound to rise. The steel industry's demand for carbonisation coals would rise a good deal in the next ten years. In addition there was, of course, the increasing demand for smokeless fuels. In all these directions the gas industry had a great deal to contribute. In particular, that part of their research programme which was devoted to providing means of total gasification of small coal was of particular importance.

Peak Load Problems

He recognised that the industry had great problems in handling peak loads, just as the electricity people would have, but he was sure that by putting the emphasis on their research on the utilisation of small coal which would become available in increasing quantity—and, therefore, if supply and demand meant anything at all, at increasingly low prices—and paying the maximum attention to the full utilisation of the type of coal that would become increasingly available, they were doing an extremely valuable job of work.

Of course, the great problem of our fuel policy, the equating of supply and demand, was that we had to face two types of cost. We had to be concerned with the costs of production, and, therefore, the price of the various forms of fuel. We had also to be concerned with the cost to our balance of payments of importing fuels. For example, the gas industry had some important ideas about the importation of liquid methane.

There was a great advantage to be gained if by these imports it were possible to produce a cheaper form of fuel, but from the point of view of the balance of payment it was interesting to find out whether those imports of a new source of primary fuel would displace large coal, for example, or whether it would displace imported oil, and whether they would contribute to helping the balance of payments problem as well as contributing to reducing the cost to industry of the fuel which it must consume. All these were factors which they had to take into account in trying to work out a rational fuel policy in this country.

He believed that the right principle to follow was to leave things as far as possible to the inter-play of commercial principles and supply and demand. He thought that by the competition between the various suppliers of fuel in its various forms they would get the maximum efficiency and the greatest service to the consumer. Certainly the gas industry was not backward in its vigorous competitive efforts, and good luck to it! As far as he was concerned, gas was the only fuel on which he could count in the amateur cooking in which he indulged from time to time.

The **Chairman,** in response and in proposing the toast 'The Guests,' said that some of them regarded with misgiving the omission of the word 'fuel' from the Minister of Power's designation. But Mr. Maudling had, in his remarks, and in those in the House of Commons, so restored their confidence that he would like to suggest a new title 'Her Majesty's Fuel Master General.' They had been heartened by his remarks and those of the Parliamentary Secretary in the debate in the House of Commons on April 30 when, after drawing attention to the damage which could be done to an economy such as ours by a marginal shortage of fuel, and to the heavy cost of large imports not matched by exports of home-produced fuel, he had advocated a policy of boldness. At the same time, he had emphasised the importance of capital costs, which might set a limit beyond which boldness in planning might become a burden to our economy.

Demand for Coal

Mr. Maudling had emphasised that by 1965, after allowing for all the coal that could be expected to be mined and for the boldest plan yet contemplated for nuclear energy, it was reasonable to expect that an additional 26 mill. tons of coal equivalent would have to be imported in the form of oil, he had said also that he did not expect the demand for coal for power stations to fall in the next ten years. The Parliamentary Secretary, in replying to the debate, had reminded the House of the vital part which the gas industry had to play, and looked forward to its expansion.

Sir Henry said he had spoken at some length on this because the debate was so very relevant to the future of the gas industry. Fundamentally, the industry was one which converted solid and liquid fuels into a much more convenient form, capable of distribution at modest cost, and subject to precise control by relatively simple equipment. The efficiency of conversion of fuel was high and the capital cost of gasworks, per therm of gas made, was very low compared, for

example, with a nuclear power station of equivalent thermal output. Nuclear power stations were no more exempt than any other power stations from the laws of thermodynamics, which laid down that if heat was converted into power much of the heat was lost, whether the heat was derived from ordinary fuel or from nuclear fission.

It was clear that traditional fuels must be used for a very long time to come, and they were convinced that if these fuels were to be used with the highest efficiency and if capital investment on the fuel and power industries was to be kept at an acceptable level tolerable to our economy, the gas industry should carry a substantial share of the fuel load.

Increased Efficiency

They took pride in the Institution in the increased efficiency of gas production which had been reported by the Gas Council and which was saving the country 2 mill. tons of coal a year or more by comparison with the rate of efficiency which was applicable in 1948. Every year they saved at least 2 mill. tons of coal, if not more. This saving had been achieved partly by the installation of new gas-making plant, but mainly by improved operation and by reorganisation of the heat and power services in gasworks. In the course of this reorganisation, back-pressure or pass-out turbines had often been installed whereby power was recovered from waste heat steam which itself was then used at low pressure for the needs of various processes.

Surplus electricity, beyond that needed for the operation of the gasworks, was often sold to the electricity supply authorities, with whom they had to maintain close contact with regard to technical matters relating to supplies of electricity from area electricity boards to gasworks and, on occasion, from gasworks to electricity boards. There were quite a number of gasworks whose surplus power was sold back to the electricity supply authorities. All he could say was that there were not enough of them. They had an arrangement which was satisfactory to both sides—a good example of give and take, and a good example of co-operation between engineers.

In the domestic market, the gas industry had always had to meet competition which was good both for the consumer and for the industry, but he felt it his duty to refer to competition which they were experiencing in some parts of the country and which seemed to be based not on purely commercial considerations, or the natural wooing of the consumer by competing fuels, but on the desire to eliminate gas from the domestic market and to replace it by electricity. In saying this, he was not referring to any difference between the Gas Council and the Central Electricity Authority; good relationships existed between the engineers in the two industries, and in many parts of the country, similar friendly relations existed on the commercial side. Elsewhere, however, views were expressed in public and policies were sometimes adopted which were clearly intended to envisage the removal of gas as a competitor in the domestic field.

Sometimes these were expressed as the comment 'gas is on the way out,' sometimes as a statement that in time it might be found unnecessary to provide for a gas supply at all; again, as a quotation of terms for the supply of electricity to houses which, if gas was also to be installed and used, were virtually prohibitive. He hoped that the good relationships between the technical men concerned might spread to some others in the electricity industry who appeared to see the gas industry as the last obstacle in the way of the all-electric home rather than as a sister fuel and power industry.

Provided that the consumer had freedom of choice, they were not worried. since 1946 nearly 7 mill. gas cookers had been sold, and they knew that the modern gas cooker was an extremely reliable and efficient piece of equipment, simple to use, with the combination of flame and tap which only gas could give.

Clean Air

Time did not permit him to say anything about clean air, save for one remark: If the Government found themselves able to relax the restrictions on hire-purchase and to reduce the rate of purchase tax on gas appliances, they would make much greater progress toward clean air and greater fuel economy. After all, oil-burning and solid fuel appliances were not taxed.

Referring to the guests, Sir Henry mentioned the Paymaster-General and members of the Ministry of Power, together with Sir George Thomson, Chairman of the Minister's Scientific Advisory Council. Other Ministries were well represented also. They were glad that Mr. Herbert Morrison, President of the Parliamentary and Scientific Committee, was present there. Many kindred organisations were represented by their Presidents and Chairmen; and research and educational establishments were also well represented by, among others, Dr. Melville, Secretary of the Department of Scientific and Industrial Research, and Professor Hawthorne, Chairman of the Fuel Research Board. Of the overseas visitors Sir Henry mentioned Dr. Boselli, President of the International Gas Union, and M. Nerot, President of the French Gas Association, and referred to the great number of representatives of the Embassies of Commonwealth and foreign countries who were also present. Sir Henry also referred to Sir Harold Smith, Chairman of the Gas Council and a Past President of the Institution, and to Sir George Evetts, by whom he had been trained in the gas industry and with whom he had worked for a number of years. Last, but by no means least, there was Viscount Bruce of Melbourne, who during a career of great distinction had helped to bring Australia to the position which she now held among the nations.

Responding, **Viscount Bruce of Melbourne,** Chairman, Finance Corporation for Industry, Ltd., said that it was a great pity that Dr. Andrews, whose paper had been read that morning, was not present, because this modern development in Victoria was of extraordinary significance to the economy of Australia. The reason why the Morwell scheme was undertaken by Victoria, with its great brown coal deposit, was because of the awkward-mindedness of New South Wales, which had all the black coal deposits. They had just set about taking it out of the hide of the rest of Australia. Victoria was a great industrial centre in Australia. They had had just about enough of that and New South Wales overplayed its hand a bit too far, and the whole of these great Morwell developments had taken place which in the end would bring retribution to New South Wales.

The President, in his address had suggested that the future depended on the scientist and on the engineer. He could not agree more, up to a point. But it had been pointed out that it would not be a bad idea if these distinguished persons had just a nodding acquaintance with accountancy, in the art of reckoning what costs were involved. If you just let the scientist and the engineer have their head, they would land you in commercial bankruptcy quicker than anyone else. He held no brief for the accountant. They were a rare breed; they could never do anything in this world. But if you could only marry the three of them—the engineer, the scientist and the accountant—then you had the answer.

Sir Harold Smith, K.B.E., D.L., Chairman of the Gas Council, in proposing the toast 'The President,' said that he was delighted to have the opportunity of doing so, for two reasons. One was because it gave him an opportunity once again to say how very much the Gas Council appreciated the work that the Institution of Gas Engineers did and how necessary it was for the good of the industry that they should have the closest co-operation between the Gas Council and the Institution.

The Gas Council had a fair sprinkling of Past Presidents of the Institution. They might be getting a little near the end of that run. Obviously it would not be a good thing if too many members of the Gas Council were also Past Presidents of the Institution, but he was quite sure that it helped both the Gas Council and the Institution to have a fair sprinkling of them.

S.B.G.I. Spring Meeting

At the S.B.G.I. Spring Meeting, held at Roehampton Golf Club on May 13, F. White won the Coronation Plate, with H. C. Dunbar runner-up.

Other results were:

Hidden Prize: Dr. F. J. Eaton.

Thornton Bowl: (1) W. Foster; (2) F. D. Drake; (3) J. A. Franklin.

Davis Cup: L. Wild.

Foursomes Competition: (1) M. H. Thornton and L. Wild; (2) J. P. Smith and O. Cronshaw. (3) F. D. Drake and H. C. Dunbar.

Visitors' Prize: R. J. Withers.

Booby Prize: C. R. Averill.

Abstract of I.G.E. Communication 506

An Approach to the Use of Oil Gas in an Integrated System

By L. P. INGRAM, M.B.E., M.Sc., M.Inst.Gas E., A.R.I.C.,
CHIEF ENGINEER, SOUTH WESTERN GAS BOARD.

THE South Western area, generally, is remote from the mining areas producing good quality carbonisation coals that yield a coke suitable for domestic use. The high ash and flying shale of much of the Somerset and Forest of Dean coals render them unsuitable for economic carbonisation, and the anticipated increased demands for good quality coke, arising from the operation of the Clean Air Act, dictate the withdrawal of any allocation of such coals to the gas industry, except in so far as sub-quality coke produced can be used economically for internal processes.

The area, however, is well situated geographically for the reception of seaborne oil and oil products. There are deep-water ports at Avonmouth and Plymouth suitable for ocean tankers and a number of smaller ports available for coastal tankers operating from refineries or storage depôts in, or closely adjacent to, the area and, in the case of Gloucester, excellent canal facilities adjoin the works.

The plant taken over by the Board at vesting date, at the Gloucester and Cheltenham works consisted of a very old horizontal retort installation at each works, 1921 continuous vertical retorts at Cheltenham, and 1943 and 1950 continuous vertical retorts (1.3 and 1.8 mill. cu.ft. per day capacity) at Gloucester. There were Jones plants (0.8 mill. cu.ft. per day capacity) and carburetted water gas plants at each works. The Jones plant at Cheltenham was the original one installed in 1941, and modified at various times, and now nearing the end of an economic life. Over the next five years, it is estimated that £300,000 would be required at Cheltenham for the reconstruction or resetting of carbonising plant and replacement of the Jones plant, with little improvement of efficiency.

The Jones plants produce gas of about 360 B.Th.U. per cu.ft. and specific gravity 0.38; consequently, it is necessary to have available an enriching gas, preferably of high specific gravity, to produce a suitable town gas. This requirement has been met, in the past, by the manufacture of the highest possible calorific value coal gas in horizontal retorts, and high-calorific value carburetted water gas.

The attractive economics of the Jones plants, due to the demand for carbon black by the rubber industry at home and abroad, dictated an extension of this process at Gloucester. Following negotiations with the Jones Gas Process Company and with the Board's carbon black selling agents, an order was placed for a third Jones plant to meet the demand for additional carbon black and to produce 1 mill. cu.ft. per day of Jones gas.

Study of Hall Process

This accentuated the need for a high-calorific value gas for enrichment, and, therefore, a study was made of the Hall process for the manufacture of gas from heavy fuel oil. It was decided to install a completely new Hall plant of 1 mill. cu.ft. per day capacity, at approximately 1,000 B.Th.U. per cu.ft., rather than the conversion contemplated, in order to prove the process in this country under the best possible conditions.

At about the same time, following investigations in France, it was decided to install a Gaz Intégrale plant of about 2.8 mill. cu.ft. per day capacity, to yield a gas of calorific value ranging from 330 to 500 B.Th.U. per cu.ft. It was considered that this plant was capable of using a number of coals from the Forest of Dean, for which the Gloucester works was well situated. Accordingly, a contract for a complete installation of W-D/I.F.E. complete gasification plant was placed with Woodall-Duckham Construction Co., Ltd. This plant may be operated as a peak-load or base-load unit, with a range that permits of the use of high-calorific value gas for enrichment, as available, or of distillate oils for carburetting.

The production pattern envisaged at Gloucester was:

Base load: Continuous vertical retort gas and Jones gas with oil gas enrichment.

Additional seasonal load: Gaz Intégrale with oil gas enrichment.

Provision for peak load: Gaz Intégrale carburetting and reformed oil gas with enrichment.

At this stage, the investigations indicated that the further extension of the Gloucester works, with the closing of the Cheltenham works and also the small works at Evesham, was a logical and economic development, and plans were, therefore, prepared for an ultimate works of 20 mill. cu.ft. per day capacity.

Higher Capital Cost

The Hall plant is designed to use any feedstock, but, for the exclusive use of light fractions, it was felt that this plant was higher in capital cost and lower in efficiency than simpler reforming plants in use in the United States.

The Koppers-Hasche reformer, operating successfully in America on propane, butane, and natural gasoline, offered great possibilities and, in conjunction with the Woodall-Duckham Construction Company a small but operational-size reformer of 120,000 to 250,000 cu.ft. per day capacity has been installed at Gloucester. These reformers are mainly used in the U.S. for the autothermic production of high-calorific value high-specific gravity gas interchangeable with natural gas; there is little practical knowledge of their cyclic operation to produce other types of gases for town use, or for autothermic operation on primary flash distillates. The above capacity range covers cyclic and autothermic operation, on each of which it is proposed to carry out detailed investigations.

The extension of the use of Koppers-Hasche—or similar—reforming plant for light feedstocks, for future gas production, has yet to be determined in the light of experience. Each of the various plants installed has been equipped with the fullest instrumentation, and, in conjunction with a detailed and accurate costing system for each process, it is hoped to obtain reliable information on which the Board's future policy for gas production may be based.

The first stage in the plan for the Gloucester Works provides for the following gas making plant.

Plant	Capacity (mill. cu. ft. per day)	Approximate Calorific Value (B. Th. U. per cu. ft.)	Specific Gravity
1	2	3	4
Continuous Vertical Retorts	3·1	470	0·49
Jones	1·8	360	0·38
Hall	1·0	1,000	0·82
Gaz Integrale	2·8	330	0·51
Koppers-Hasche	—	—	—

Coal for carbonisation or for complete gasification is received via private rail sidings and the usual mechanical-handling plant. Oil feedstocks are delivered by canal barges of 450 tons capacity from the Llandarcy refinery (near Swansea) in South Wales, or from bulk storage at Avonmouth. Separate storage of 3,000 tons total capacity is provided for fuel oils, gas oil,

and light feedstocks, such oil products being pumped by the barge pumps direct to storage by appropriate pipelines, steam-traced as required.

Ancillary plant, generally, is of orthodox types, but three systems for removal of hydrogen sulphide are in use—oxide boxes, liquid-purification plant, and Gastechnik purifiers.

Three Jones plants were built in this country during the early years of the second world war, mainly to provide capacity for peak-load or emergency requirements. These were designed by the late Mr. Leon B. Jones, based on his Improved Oil Gas Process, which had been in wide use on the Pacific Coast of the United States of America.

The gas-making process is one of thermal cracking, producing a residual carbon by-product equivalent to about 40% of the total oil input, dependent on the fuel used. The American plants recovered this carbon as a paste which was briquetted and sold mainly for boiler firing. In this country, such an outlet was not available at economic prices, and, after prolonged research, a process has been developed to recover over 80% of the carbon made as a dry product of the high standard of quality demanded by the rubber industry.

This development has resulted in the emphasis being placed on carbon black production, with gas as a valuable by-product, instead of the original gas production with carbon as a disagreeable and troublesome by-product. A consistent carbon product is essential, and this necessitates continuous production to maintain constant conditions of plant operation. The resultant gas must, therefore, be considered as base-load production.

Cyclic Process

The operation of the original plants has been described, but, briefly, the process is cyclic, consisting of heat and make runs, and reversible with alternate halves of the complete cycle proceeding in opposite directions through the two generator and regenerator chambers.

The make gas leaving the generator unit carries carbon black of an average particle size of about 300 millimicrons, and the bulk of this is recovered by means of cyclones. It is essential that this product is free from extraneous matter and completely dry.

Although no tar, in the true sense, is produced by the process, the small amount of oily matter and some undecomposed steam in the gas make it necessary to recover the carbon directly from the hot gas. The carbon, even when hot and dry, has an inherently sticky nature, and it is necessary to use vibrators to ensure the discharge of the recovered material. During the make portion of the cycle, the bases of the four carbon-recovery vessels are sealed with specially developed slide valves, these valves being opened during the 'heat' portion of the cycle to deliver the recovered carbon into subsidiary hoppers. From these hoppers, the hot carbon is fed, by means of rotary extractors and a system of air-tight water-jacketted spiral-screw conveyors, to an elevating unit that delivers to hoppers feeding a gyratory sieving machine and bag-filling and weighing machine.

The hot gas leaving the last cyclone still contains 15% to 20% of the original carbon black, and substantially all of this is removed in the washbox as a water slurry with condensed oily matter. The washbox also serves as the water seal on the outlet of the plant. After leaving the washbox, the gas passes through a spray cooler, a coke filter, and a packed scrubber-condenser to the relief holder. A pilot plant has recently been developed for the recovery of the 'carbon paste' from the washbox as dry carbon black.

The American gas industry has long taken a keen interest in oil products as primary raw materials for gas making. At the end of the second world war, when the use of natural gas was developing very rapidly, the use of thermal cracking plants of various designs to make gas, with a calorific value of about 1,000 B.Th.U. per cu.ft., became common, mostly for stand-by and peak-load purposes on natural-gas networks. These processes, however, could only use distillate oils, because they were not equipped to handle the large amounts of carbon produced when using residual oils.

The first attack on this problem was by means of so-called 'back-blast' processes, in which carbon produced during the gas-making period was burnt off during a separate portion of the cycle by means of air entering the set at the superheater outlet. This air became hot enough, by the time it reached the generator, to burn the carbon, but the waste gases so formed left the set at a high temperature, and the heat contained in them could only be recovered as waste-heat steam. 'Back-blast' sets, therefore, had a limited gas yield and were, in any case, unsuitable for oils containing more than about 6% of Conradson carbon.

The logical development from this position was the fully regenerative set devised by Edwin L. Hall and sponsored by the American Gas Association. The first trials, at Baltimore in 1949, which were wholly successful, employed the carburetters and superheaters of two water gas sets with the carburetters linked at their tops; this so-called 'four-shell' construction has, however, been largely superseded by a 'two-shell' design in which only two banks of chequers are employed, and which is somewhat cheaper to build. These Hall sets have proved themselves able to gasify some of the heaviest residual oils containing up to 15% of Conradson carbon.

The operation of the Hall process is based on a four-part cycle in which a heat and a make period in one direction are followed by a heat and a make period in the opposite direction. By this means, sensible heat losses in both make and heat gases are reduced to a minimum, and waste heat from the latter is only about sufficient for steam requirements. A make period begins with admission of steam to the left-hand vessel at the base; make oil is then sprayed simultaneously into both vessels from the top and is vaporised, partly by the sensible heat in the superheated process steam and partly by heat from the brickwork. During this phase, a quantity of carbon, roughly equivalent to the Conradson value of the oil, is deposited on the uppermost chequers; further down the right-hand vessel, the oil vapours are fixed and a further, smaller, amount of carbon is formed. The product gases leave the set via a three-way valve, refractory lined main, and washbox.

During the following heat period, air is admitted at the base of the right-hand vessel and is heated in the lower chequers so that it is capable of burning off the carbon deposited during the previous make phase. By burning the carbon off every cycle in this way before it has had time to graphitise, manual removal of carbon and special scurfing periods are entirely eliminated. With the heaviest oils, the heat released by this combustion may be sufficient to maintain the process, but with other feedstocks some heat oil is sprayed into the top of the left-hand vessel and an appropriate quantity of secondary air is admitted to the cross-over connection between the tops of the twin generators.

Experience over several years has shown that, with proper attention to chequer temperatures, the calorific value of the finished gas may be varied in the range 950 to 1,300 B.Th.U. per cu.ft. Below this range, overcracking results in a tar that is difficult to handle because of the high free-carbon content, while above it undercracked oil appears in the tar and gives rise to stable tar emulsions.

Two-shell Design

The plant erected at Gloucester is of the two-shell design, having a nominal capacity, when gasifying heavy oil, of 1 mill. cu.ft. per day, this figure being increased by about 50% when using gas oil or other distillate.

The set is entirely automatic in operation, and a system of secondary interlocks has been incorporated on the hydraulically operated valves. This secondary interlocking gear is electrical, and is designed to ensure that the set is shut down if any of the valves fails to respond within a preset time to the command of the corresponding lever in the automatic operator. Another device incorporated in the mechanical operator ensures the maintenance of proper temperatures in the set by prolonging the heat period slightly if the required temperature has not been reached when the make period is due to begin.

The Gaz Intégrale plant at Gloucester will be worked on a back-run cycle, and will normally gasify weakly swelling high-volatile coals to make a gas of about 330 B.Th.U. per cu.ft. For peak-load purposes, however, the calorific value may be raised to 500 B.Th.U. per cu.ft. by carburetting.

The Gaz Intégrale system of complete gasification is now well known. Briefly, the generator has a lower portion substantially similar to a modern water gas generator with a rotating grate of the dry-sealed type, allowing high blast pressures to be used. Above the generator is the refractory lined distillation zone in which the coal is carbonised by rising hot

water-gas; this is divided into sections by hollow radial walls through which blow gases pass, providing a further supply of heat for carbonising. The ancillary chambers are refractory lined and filled with chequerwork of a special design, except the carburettor, which is chequerless. The plant is completely automatic in operation. An interesting mechanical feature is the coal-feeding device, comprising a pair of rotating drum valves, which automatically maintain the coal level inside the generator.

The Koppers-Hasche plant, which was developed in the first instance by Dr. R. L. Hasche, of the Hasche Engineering Corporation, and later sponsored by the Koppers Company of Pittsburgh, is new in this country. In the United States, however, an autothermic version of the process has become established, since the second world war, for the reforming of propane, butane, and low-boiling petroleum fractions to give fuel gases with a calorific value between 600 and 1,200 B.Th.U. per cu.ft. The units are compact and cheap in comparison with other types of gas making equipment, and high efficiencies of the order of 95% are reached. The product gas contains up to 50% of inerts, with a correspondingly high specific gravity. This generally would limit the proportion that could be tolerated in town gas in this country.

Advantages Over L.P.G.

Consideration is being given to the conversion of the isolated North Devon group to distribute only autothermically reformed light distillates, with appropriate adjustment of all consumers' appliances. Such reformed gas has advantages over a liquefied petroleum gas—air mixture as it contains substantially no free oxygen, and has a rather lower specific gravity.

A considerable amount of experimental work has been done in the United States on the cyclic operation of the reformer for the production of gases rich in ethylene and acetylene, which are extracted for use by the chemical manufacturing industry. The ability of this unit to make gases of widely varying compositions led to the suggestion that a gas approximating to town gas could be produced. An experimental unit has, therefore, been erected at the Gloucester works, in collaboration with Woodall-Duckham Construction Co., Ltd., the sole licencees in this country, to investigate the use of various feedstocks and the production of a range of reformed gases. This unit is now at work and preliminary operation with propane has enabled experience to be gained of the mechanics of the plant.

The next stage in the investigation will be concerned with the use of primary flash distillates as feedstock. This material is freely available at a price that makes direct production of town gas from it, in a unit of relatively low capital cost, a very attractive possibility. It is hoped later to study the reforming of Hall gas to a lower calorific value gas. This plant can be used in two ways:

In the autothermic version of the plant the heart of the reformer consists of a pair of equal regenerative masses formed of high-purity (99%) alumina tiles. The tile mass is encased in high-alumina and insulating brickwork inside a steel shell. The hydrocarbon to be reformed is usually propane or butane, and in operation use is made of the vapour pressure of the liquid to inspire the necessary air. The liquid hydrocarbon is pumped through an externally-heated vaporiser to the injector where a controlled quantity of air is entrained. This mixture passes through a reversing valve, enters the upstream regenerator and is rapidly heated to the oxidation temperature. The reformed gases return through the downstream regenerator to the reversing valve and are cooled in a direct-type gas cooler.

This operation transfers heat from the upstream to the downstream regenerator, and the flow of reactants is, therefore, reversed at intervals of approximately 1 min.

Little mechanical equipment and instrumentation are needed for such an installation. The reversing valve is air-operated and is controlled by a small electric timer and controls are simple. The calorific value of the make gas is controlled almost instantaneously merely by throttling the air supply to the injector. Such indeed is the simplicity of the plant that at least one installation in the United States has been adapted for entirely automatic operation, being started and stopped by the varying height of the small relief holder.

In the second version of the plant, comprising cyclic operation, the heart of the unit, as in the case of the autothermic reformer, is a pair or regenerative tile masses composed of the grooved-alumina Hasche tile. The operating cycle consists of four phases with each phase lasting approximately 1 min. During a heat phase air from the blower enters one end of the reformer and burns with town gas admitted to the centre combustion chamber, the products of combustion leaving the far end of the tile mass at a low temperature. After a short purge, the main three-way and four-way valves change over and the make period commences with the admission of vaporised feed and steam at the opposite end, the gas made passing away to the gas-cleaning train. These two phases are then repeated in the reverse sense, thus completing the four-part cycle.

The Jones plants normally operate with a medium fuel oil of 950 sec. viscosity. The plants have been run on gas oil for trial periods, giving a higher gas production, but lower carbon black yield, per gallon of oil. It is proposed to run tests on primary flash distillates, which will result in even lower carbon black production, but the increased throughput thought possible, and the higher value of the resultant sulphur-free black may compensate for the lower unit yield and provide additional gas output. Tests on the use of Hall tar are also envisaged.

The Hall plant is designed to utilise any grade of feedstock, from 3,000 sec. heavy fuel oil down to primary flash distillates, and only with experience of their use and an appreciation of current market values of the various fractions can the most economic operation be assessed. The higher tar production from the heavier fractions has little economic effect under present conditions, with very small difference between tar and fuel oil prices. The Gaz Intégrale plant is equipped for the use of gas oil or light fractions for carburetting. Normally, carburetting will not be employed, but it is intended that light fractions will be used for this purpose for meeting peak outputs. It is estimated that up to 300,000 cu.ft. per day of Hall gas can be reformed through the Gaz Intégrale generator, which, with the necessary cold enrichment by other Hall gas, will absorb any surplus production of this gas. The Koppers-Hasche plant generally operates on feedstocks that are either vapours at normal temperatures or are easily vaporised.

Light feedstocks are practically sulphur-free, and a substantial proportion of gas made therefrom in relation to total works output would make a valuable contribution to the reduction of the organic sulphur content of gas distributed.

Steady Rate of Extraction

The system of gas mixing and automatic calorific value control for the gases from these plants is necessary. The Jones, Hall, and Gaz Intégrale plants are cyclic in their operation, and each gas is made into a separate relief holder. A common exhauster extracts the gases from the three relief holders though independent mains and meters, mixing taking place at the inlet of the exhauster. The calorific values of the individual gases are continuously recorded by 'Sigma' calorimeters, with provision for regular checking by Boys calorimeters. Controllers maintain the Jones and Gaz Intégrale relief holders about their mid-height, or in any other desired position, but are so adjusted that the normal cyclic movement of the relief holders can take place while the rate of extraction remains reasonably steady.

Gas mixing with automatic control is now well established, and an essential feature of suitable equipment is the shortness of the time lag that occurs between a change in the calorific value of the mixed gas and the corresponding corrective action of the control instruments.

The 'Sigma' calorimeter, with metallic expansion-measuring element, and inherently low time lag, has been selected to operate in conjunction with a George Kent 'Mark 20' air-operated controller. Great care has been taken to keep the length and volume of the gas sampling pipes to a minimum. As the mixed gas leaving the exhauster is crude 'Sigma,' model purifiers are installed in the sampling lines and the time lag introduced by the purifiers has been reduced to about 5 sec. The total sampling and measuring lag is not more than 1 min. Straight-line control is virtually impossible owing to an unavoidable lag in any system, but by the use of a three-term controller, giving proportional, integral and derivative action, variations in calorific value are practically eliminated in the mixed gas, after passing through the normal ancillary plant and a mixing holder.

The two low-calorific value gases, Jones gas of 360 B.Th.U. per cu.ft. and Gaz Intégrale gas of 330 B.Th.U. per cu.ft. are enriched by the controlled admixture of Hall gas of 1,000 B.Th.U. per cu.ft. into each stream at the inlet of the exhauster. Extraction of gas from the Jones and Gaz Intégrale relief holders is controlled, according to the holder levels, by means of butterfly valves in the Jones and Gaz Intégrale/Hall lines to the inlet of the exhauster. The butterfly valves are operated by compressed air power cylinders from Kent 'Mark 20' controllers linked to the holder height indicators.

The rate of Gaz Intégrale gas flow is measured by means of a ring balance-type indicator, and a pneumatic pressure proportional to this rate is transmitted to a similar instrument operated by the Hall gas flow. The resultant differential pressure, by means of a ratio controller, operates a power cylinder coupled to a butterfly valve in the Hall gas main to maintain constant volumetric proportioning of these two gases, resulting in a mixed gas of approximately the desired calorific value. The admixture of Hall gas with Jones gas is controlled by means of a butterfly valve in the Hall gas main, operated by the Sigma-Kent calorimeter in accordance with the calorific value of the mixture of the three gases at the outlet of the exhauster.

The coal gas, as a separate stream maintained by normal control at the declared calorific value, will join the Jones/Hall/Gaz Intégrale mixed gas stream at the inlet of the mixing holder. As the characteristics of the two gas streams are shown later to be very similar, no special precautions are being taken to ensure their homogeneous mixture.

Information is freely available on the capital costs of traditional gas-making plant. Comparable figures for Jones, Hall and Gaz Intégrale plants are £174,000, £100,000 and £136,000 respectively, per mill. cu.ft. per day capacity. These figures relate to the capacities at the normal calorific value of the gas made, and for strict comparison, on the basis of an equivalent of 1 mill. cu.ft. per day at 500 B.Th.U. per cu.ft., they should be amended to £242,000 for Jones plant, and £50,000 for Hall plant. These capital costs, however, have little meaning unless they are related to the load factors realisable in practice for the duties the plants are to perform. The only true basis of comparison is that in which the total annual charges are spread over the actual total annual load that can be achieved under normal operating conditions.

Costs for Comparison

If carburetted water gas costs are given for comparison, based on 12 mill. cu.ft. per day, continuous vertical retort plant on base load with a normal repair cycle, and 8 mill. cu.ft. per day carburetted water gas plant meeting all additional demands, the weighted average cost for the proposed Gloucester output would be of the order of 11d. per therm. The combination of Jones, Hall and Gaz Intégrale gases envisaged would result in a mixed gas at about 9.1d. per therm.

It is appreciated that, with the limited market for carbon black, this combination is not of general interest, but it does give an opportunity for the investigation of oil gas processes to meet these special needs, which may, perhaps, result in developments that would be of value in more general conditions.

DISCUSSION

Mr. C. H. Chester, C.B.E. (Chairman, South Western Gas Board): 'When the President very kindly asked me if I would have a paper prepared by our Chief Engineer, having special reference to the design and use of special base-load and seasonal-load plants, it had been hoped that we should have progressed much further with full-scale investigations on work at Gloucester, but due to the incidence of the Suez crisis and other unforeseen difficulties, unfortunate delays have occurred. But we will promise our President the correct information, good, bad or indifferent, as soon as it is complete.

Need to Extend Study

'In 1954, my Deputy Chairman, Mr. Carr, and I visited the United States of America and France with the Chief Engineer, following our study over a period of years of the real savings which can be achieved by firm centralised control of production and major distribution over a wide area. We soon found it very necessary to extend the study beyond base-load working and peak-load working to seasonal variations in demand involving a co-ordinated major repair programme. The paper, I suggest, gives the reasoned approach to this important problem without, unfortunately, indicating conclusions which depend on final figures which are not yet available. The paper, therefore, must be considered in this light as an interim report on thinking which has been going on for several years in order to achieve lower costs of production and distribution and minimum capital expenditure.

'The effect of transport charges on coal in an area which is the furthest remote of all area boards in this country from the coal supplies, and the necessity to take from the coke market sub-standard coke made from poor quality coals in the Forest of Dean and Somerset fields has also had to be considered. Inferior coals, still necessarily taken in the present shortage position, can now be concentrated in suitable works where provisions for the total destruction of the coke will be most economical, although unfortunately still a charge by the transfer of surplus above that used locally in producers and in water gas manufacture, to other works reasonably adjacent.

Serious Proposition

'With the coal position in the South Western area as it is, the use of the various products from oil refineries must be considered a serious proposition for seasonal and peak loads. It is anticipated, also, that the lighter distillates from the refineries may be used as base-load gas-making materials in lieu of inferior coal at suitably selected points on the integrated system of supply, with the possibility of increased coke production by steady coal throughput at other stations, and that is a practice which is now in use in two or three of our larger undertakings. The latter stations have been proved to work more economically in meeting local variations in gas demands with a more orderly coke production, particularly where requirements for coke have previously exceeded local supplies, with the internal use in the producers of coal gas surplus at certain times of the year, enabling the stocking of coke to meet excess demands at other periods of the year. An extension of this procedure is planned in order to make better use of expensive capital invested in carbonising plant of modern design. The acceptance of such a thesis results in the provision of less seasonal and peak-load plants for a true economic balance.

'Gloucester, which is suitably placed to receive a variety of fuels and also suitably positioned in relation to the seasonal and peak-load demand on the integrated distribution system, has been selected by the Board for an extensive development. Complete gasification of coal in the Gaz Intégrale plant, with provision for carburetting by either traditional gas oil methods or by light petroleum fractions, or even the cracking of Hall gas of approximately 1,000 B.Th.U. from any type of oil distillate, ranging from the lightest to the heaviest, and the pioneer Koppers-Hasche and specialist Jones plants are being investigated.

'The combustion characteristics of the gases produced from such a variety of plants have been calculated and well studied, and the Board consider that the essential interchangeability of these gases with normal base-load gas justifies planning for three variable load works only in the Board's area.

National Policy

'We considered that the use of complete gasification plants with coals other than those carbonised traditionally in the gas industry, coupled with suitable enrichment such as may be provided by Hall gas or Koppers-Hasche gas, and blending with Jones gas, would fit into the national policy on coal and the provision of gas at the most economical price. At the same time, this supports the Clean Air policy by an orderly coke production, and is preferable to the use of carburetted water gas plants which, though still very useful, might be considered too easily ready for improvident use outside a designed fuel policy within the area Board. At the same time, with the port facilities at Avonmouth and

Plymouth, should natural gas be imported, the facilities and the experience of various qualities and various quantities of gas will be available for the distribution of this gas in our completed grid. We have also considered it wise not to put all our eggs into one basket in the design of this seasonal and peak-load plant at Gloucester, since oil prices may not be fully economical at all times and supplies may even be interrupted, as we do well know recently.

'The effect on our long-term programme for complete sulphur removal will be studied at Gloucester, with particular reference to the quantity of organic sulphur produced from various oil feed stocks. The cost of the provision of expensive purification plant and sulphur removal plant will be affected materially if such plants of a limited number are required to deal with base-load coal gas only.

'We have set up a special cost accountancy section at Gloucester in addition to our top level technical and supervisory staff and on their joint investigations the long-term policy of the Board will be formulated; it is regretted that in this respect the paper so far is therefore not complete. However, the results to date on the Hall, Koppers-Hasche and Jones plants, and the information available from other Boards on the Gaz Intégrale plant, are sufficiently encouraging to give rise to the hope that within a year we shall have the knowledge on which to plan the centrally controlled production for the area, in conjunction with a distribution system already installed.

A Lot of Work to Do

'The effects on compressing and distribution costs and holder capacities and their position comes very much into the study of this problem, and while not fully covered in the paper, I know that these have not been overlooked.'

Mr. Chester concluded: 'I am sure that Mr. Ingram would agree that he and his staff have still a lot of work to do before we are in this final position, but he is to be congratulated on the orderly approach indicated in the paper to the problem of gas manufacture and distribution over an area 260 miles long, with varying types of gas demand, and I personally am grateful for this record of the work done to date.'

Mr. H. S. Cheetham: 'Mr. Ingram has presented us with a most interesting and rather unusual paper. Most of the papers presented to this Institution relate experiences which have already been gained either on the works or in connection with distribution, whereas Mr. Ingram's paper commences with an examination of a set of circumstances and a statement of conclusions leading to decisions to install certain types of plant, some of which are still in course of construction. Mr. Ingram has promised us full information on these plants and their operating results in due course, and so he cannot be criticised on the grounds we sometimes hear that some of us report only when the plants of our choice have proved successful and do not give others the advantage of hearing if they are not so successful. We look forward with very much interest to receiving Chapter 2 in due course, when we can learn the extent to which the Board's expectations have been fulfilled.

'The Hall and Koppers-Hasche plants are the first to be installed in this country, and the Hall plant is only the second of its type to be installed in Europe—the first, having a thermal capacity equal to 13 mill. cu.ft. of town gas daily, is now in operation at the Alfortville (Paris) works of Gaz de France.

'The Gaz Integrale plant is only the second to be installed in this country—the first is in routine operation at the Kensal Green works of the North Thames Gas Board—and I believe I am correct in stating that the Jones plants in Gloucester are the only ones of their type in this country and, indeed, in Europe.

'All this pioneering on the part of the South Western Gas Board is of great value to the industry as a whole, and I suggest that we are much indebted to them.

'In this changing world of today, flexibility is essential and not the least requirement is the ability of our plants to utilise a variety of gas-making materials, either liquid or solid. The particular coal which we use today may not be available to us tomorrow, and many of us remember that heavy oil, which was a few years ago in abundant and cheap supply, is today by no means the most readily available liquid hydrocarbon.

'The Hall plant in Gloucester has been in operation for a relatively short period and it was, in fact, necessary for it to be started up in advance of provision for proper measurement of the gas; it has demonstrated its ability to produce gas from high carbon oil at a rate considerably in excess of the original guarantee. It is the intention of the South Western Gas Board to try out a variety of feedstocks and, in this connection, it is important to note that sulphur in the feedstock does not present any problem.

Disadvantage ?

'Tar production in a Hall plant using heavy oil is greater than in some other types of oil gas plant, and I have heard it suggested by engineers in this country that this is a disadvantage. This view is not shared by users of Hall plant in the U.S.A., who regard the tar as a better fuel, for a number of purposes, than the oil from which it was produced. I believe that this opinion holds also in France.

'The Koppers-Hasche plant in Gloucester is, as Mr. Ingram has stated, a small experimental installation and some may wonder why it should be necessary to experiment with a process and plant which is already well established abroad. It is the intention of Woodall-Duckham at all times to make available to the gas and other industries in this country processes and plants which have been tried and proved in their countries of origin, but it is, however, their experience that although such processes and plants may meet foreign requirements, considerable modifications to either, or both, are often needed to fit them for satisfactory service in this country.

'The reliance which is placed on Koppers-Hasche plant in the U.S.A. was demonstrated very clearly at Keene, New Hampshire, to which works I have the pleasure of accompanying a party of British engineers in 1955. The town is supplied entirely by the Koppers-Hasche plant using butane as a feedstock and the works personnel, few in number, are on the works only during the day shift; at night the local taxi service takes over! The plant is fitted with a number of alarms which come into operation in the event of abnormal conditions arising. At night these alarms sound in the office of the local taxi service, whereupon the taxi driver on duty duly collects the works foreman—an excellent example of automation!

Useful Experience

'The Gaz Integrale plant now in course of erection in Gloucester is generally similar to the many installations in routine operation on the Continent. Such installations comprise, in most instances, the whole of the gas-making plant on the works and they have demonstrated their ability to gasify a range of coal not normally used for gas-making. Most useful experience is now being gained with the first British plant built for the North Thames Gas Board and the further experience to be obtained in the south-west will be very valuable.

'As already mentioned, we all look forward to hearing further from Mr. Ingram when, in due course, his several plants are in operation, and while the individual operating results will be highly interesting, we are equally anxious to hear the Board's experience in what we might describe as the tactical combination of the processes and plants in town gas production.'

Mr. R. Prince (Chief Engineer, South Eastern Gas Board): The South Western Gas Board and the author are to be congratulated upon the phase of development described in the paper. Having completed the integration of the former undertakings, so far as is economically justified, a production plan has been devised which takes advantage of the greater use of oil gasification which not only gives some measure of independence from the continually increasing cost of coal, labour and capital charges, but which, at the same time, gives the maximum degree of elasticity in meeting the variation in gas demand and the most effective means of mutual support between neighbouring works. In an area most difficult to administer economically, the maximum advantage has been taken by developing those works which are provided with natural facilities to receive their raw materials most cheaply.

'The variation between base, seasonal and peak loads accords generally with

the experience of the South Eastern Gas Board, which has taken similar measures in meeting this problem by extensive integration, by the introduction of oil gasification on a large scale and the extension of the use of other gasification plant.

'The author draws attention to the advantages of the partial firing of retort settings by town gas to absorb temporary surpluses of capacity, the release of additional coke for sale and the balancing of load factors of gas production plant. I suggest that closer study by engineers of this practice would pay dividends, for in many works it will be found that the cost of underfiring by coal gas is no more than by producer gas, with all the benefits enumerated. We have found this practice of particular advantage at our East Grenwich works, where the coke ovens can be switched over to town gas firing most readily.

'The performance of the several gasification plants installed at Gloucester will be watched with interest when a sufficient time has elapsed to evaluate their results.

Market for Carbon Black

'The author refers to the attractive economics of the Jones plants, but these, of course, depend entirely upon the market for carbon black, and if we all decide to install these plants the economics would soon become unattractive. This remark is not intended as either an ultimatum or a threat!

'I found that Section 6 of the paper giving a description of gas mixing and control is of great interest, but I could not help but wonder if the mechanism involved was not over-complicated for works of the capacity of Gloucester, where I imagine technical control is limited. The author does not give particulars of the technical staff employed, and I should be interested to know whether shift engineers are employed or, if not, who is responsible for the gas mixing controllers outside normal working hours—perhaps they use the local taxi service, as suggested by Mr. Cheetham!'

Mr. J. A. Prigg (Watson House: 'The performance of appliances on the district when supplied with unconventional gases is a subject to which we have given considerable attention at Watson House. Mr. Ingram has furnished us with data on the gases produced by the Jones, Hall and Gaz Integrale processes.

'It is clear from Table 5 of the Paper that little trouble is to be expected on the district from the mixtures of these gases proposed by Mr. Ingram. The Gaz Integrale-Hall mixture is somewhat low in Wobbe Number, but it is wisely proposed to limit the proportion of this gas in the mixtures to about 30% so that the Wobbe Number will not fall more than 5% below the average.

'In the case of the Koppers-Hasche plant, it is suggested that a combination of autothermic and cyclic operation may be used. The autothermic process is of high efficiency, but produces gas with a tendency to lift. By judicious mixing, however, say with gas from the cyclic operation, it is possible, as Mr. Ingram points out, to avoid this difficulty.

'For two reasons it will be of very great interest to have further details of the combustion characteristics of these gases when they are available. In the first place, it would be interesting to know how the characteristics of the gas will vary with the normal running of the plant. Just as at present in conventional plants the variations of materials and operation can lead to variations in gas characteristics, so we must presume that these plants will give their variations.

'Secondly, we would like further details for a rather more academic reason; last November, Mr. Gilbert and I had the privilege of presenting to the Institution a report on our work entitled "The Prediction of the Combustion Characteristics of Town Gas." From the method set out in that Paper we have deduced that the Jones-Hall mixture described by Mr. Ingram, will have an Aeration Number of about 60, that is, very similar to that of the present gas. The Gaz Integrale-Hall mixture, however, will be somewhat harder with an Aeration Number of 50-55. This latter gas, nevertheless, should give reasonably stable flames with regard to light back on appliances adjusted for the present gas. Weaver's method of predicting interchangeability suggests, however, that this gas will light back. Perhaps Mr. Ingram will be able to tell us which of us is right.

'Finally, I wonder what these gases will smell like. The Hall gas with its high unsaturated hydrocarbon content will probably have a strong smell, while the low calorific value gases will probably have little smell. Have the resultant mixtures sufficient distinctive odour, and does it resemble the smell of the present gas?'

Dr. A. E. Haffner: 'Although the Koppers-Hasche plant has been developed on a two-way basis with such a smooth change-over of valves that it is not regarded as cyclic, it is not normally divided into a heating phase and a make phase, and consequently the nitrogen associated with the air contaminates the gas produced. The air admitted, however, has the great benefit of supplying heat autothermically at the time and place of the gas-making reactions.

Two Difficulties

'To split the process into a heat phase and a blow phase and still produce a gas at 500 B.Th.U. there are two difficulties. The temperatures must be raised much higher, firstly to allow for heat generated in the blow to be available for the endothermic reaction of the make period, and secondly to carry the reforming to simpler molecules of sufficiently low calorific value because diluent nitrogen is no longer available. For this necessary raising of temperatures does any carbon blockage occur in the small free space in the Hasche tiles? It is in these directions that the British gas industry is interested in the adaptation of this elegant process, and we hope that there will be a more detailed account of Gloucester experience than has been covered in four lines on page 32 of the paper.

'These results have been promised, but they are of such pressing interest to other engineers in the gas industry that we are asking for answers even while the data on which the answers will be based is being produced!

'I was in the party which saw the automatic operation of one of the American Koppers-Hasche plants, and I was very much impressed by it. As Mr. Cheetham has said, it did start and stop during the night without any attendance at all. If the holder became full (and there was only one district holder, not a relief holder) through the make exceeding the demand, the plant shut down, the steam boilers shut down, and the plant waited until consumption reduced the stocks. When the holder reached a low level, up started the butane-fired boiler, up started the plant, and the gas began to trickle into the holder again. If for any of several reasons the plant failed, not only did it ring up the local taxi service, but sent a message to the foreman as well—it did everything but leave a note for the foreman's wife that he would be back in five minutes!

Valuable By-product

'Many years ago I was involved in carrying out observations while the Jones plant at Newport was started and operated by Mr. Leon B. Jones himself—a man of incredible vitality. In those days the carbon was a troublesome by-product filtered off as a scum from the wash box and the paste burnt with some difficulty in Lancashire boilers. Now the carbon is a valuable by-product which has a dominant effect on the economics by its ready sale to the rubber industry. Carbon deposition which is feared and avoided in most oil cracking processes is thus economically exploited. This has implemented the advice from two separate wayside pulpit notices: "Alcohol is your worst enemy!" and "Treat your enemy as your friend."

'Mr. Ingram is to be congratulated on his selection of plant which offers new possibilities in the flexibility of gas production from a diverse series of feedstocks. He could have selected conventional plant of proved performance, but thank goodness the South Western Gas Board has the enterprise to try something different—a combination of processes which very much needs to be explored not only for themselves but for the gas industry.'

Mr. H. F. Buxton (South Eastern Gas Board): I was particularly interested in the diagram showing the steam balance given in Fig. 10 of the paper and its relationship to the electrical system at the Gloucester gasworks. I was most interested to see a reference made to the use of induction alternators as parallel drives for the air blowers on the Hall and Gaz Intégrale plants. The uses, merits and disadvantages of induction generators have long been debated and will continue to be debated, particularly where they are built of large sizes and where it is sometimes considered that

their limitations are such as to make synchronous machinery more desirable; but it does seem to me that in this case an almost ideal use has been found for induction generators, and I would welcome more information at a later stage on their operation and performance.

'There is one question I should like to ask with regard to control of these machines. Are they started from the steam end—that is to say, do the turbines start first and are the induction generators switched when they are up to speed—or are they started as induction motors in the normal way? If the first is the case, I should like to know whether there are any special steps taken to avoid those very violent transient surges which can be damaging to the supply system should switching inadvertently take place at or very near the synchronous speed of the machines.

'I realise that this is probably a little departure from the main object of the paper, but these are things which are likely to be with us in the future, and a little information of that sort would, I think, be most helpful to many of us who are concerned with the subject.'

Mr. L. J. Clark (North Thames Gas Board): 'Many speakers on previous occasions have emphasised that the industry must extend its flexibility both in its types of processes and in its raw materials. Here we have a number of development projects all going along with variable feedstocks and variable processes themselves, and we look forward very much to further results from them.

'I noted that there was a suggestion that in these various combinations of plants it might be a good thing sometimes to operate them in series. It was suggested that high B.Th.U. in the gas made in the Hall process could be passed on perhaps for further cracking in the Gaz Intégrale plant or maybe in the Koppers-Hasche. Here there is just one very elementary point that I should like to stress, because it comes into a number of these processes. We all know the elementary fact that a process at 80% efficiency operating in series results in 64%. That also applies to some other processes which have been put forward and are being tried out where there are series operations. Several other developments work on the principle of trying to operate the process in parallel, that is, if you have one which produces gas at a high B.Th.U., say, like the Hall gas at 1,000, then you try to find another one which will produce a high hydrogen content gas, down in the region of 250 to 300, and then mix those in suitable proportions to give a gas declared C.V. There is no question of multiplying the efficiencies, and the result is somewhere in the region of 75% to 80%. This is an elementary point, but it is one which I think has occasionally been overlooked on some Continental plants.

'Several of the overseas developments are helping us in these spheres. In America, of course, the Hall plant has been used extensively and has proved itself particularly suitable for providing peak-load gas during the winter time when the transmission mains are loaded to capacity. I visited a number of these plants. Of course, one always asks what are the problems about the tar, and the impression that one always gets is that the engineers are jolly pleased when February or March comes round and they can afford to shut down the plant—and usually by that time everybody is just about swimming in tar! I do not think that we can say yet that the tar problems of the Hall process are fully solved, not from American practice, at any rate.

'The Koppers-Hasche process is a very nice little process, and other speakers have referred to it. I have seen some of them in the United States, and they do lend themselves very well to automatic operation. They are not, of course, entirely free from troubles. The Keene plant is one that I have seen on two occasions. Perhaps I had an advantage in visiting it not with a party and of talking to the foreman on the job and hearing of some of the day-to-day problems. They have their troubles there with naphthalene and gum, and as recently as four months ago they were in quite serious trouble with gum.

Lost Capacity

'Considerable developments have also gone on in the United States in developing the process for cyclic operation, and from the results that I have seen of that process, it appears to produce quite exceptional gas of a satisfactory Wobbe Number, and the only drawback to the process is that you do lose capacity and the output drops to somewhere in the region of 60% of what it would be if operating continuously.

'Finally, I should like to refer to refinery gas, which is coming into the picture very much nowadays for several of our developments. Here we can learn quite a lot from the work done by Gaz de France, who have been working with refinery gas for a number of years. Once again, there is an elementary principle here that if you have refinery gas to treat, then you should treat the minimum quantity that is absolutely necessary—in other words, put the minimum amount through a plant and produce gas of as low calorific value as possible and a high hydrogen content, and then cold enrich that gas with the refinery gas itself. By so doing you lose nothing whatever on the coal enriched gas, and the resulting overall process can be very favourable.'

Mr. L. P. Ingram, in reply, said: 'I am very gratified with the excellent discussion which has taken place, and I am particularly grateful for the number of very helpful comments that have been made. Some of the questions raised obviously need study, and I am sure you would not expect me to reply to them today—and particularly I would suggest that Mr. Buxton would not expect a reply from a gas engineer. I will consult our electrical engineers and let him have the information.

'Mr. Prince raised the question of using coke. We have a number of outlandish areas in the south-west where this process is of particular application, and Bude was chosen as the original one because we always make less coke there than we want for sale, and it is a long way to send coke from anywhere else. That seems to be an ideal situation in which to experiment. We did over a period of two or three months learn the technique of it, and we got up finally to perfectly satisfactory operation, with up to 40% coal gas on an I.B.C. installation, merely injecting the gas above the fire bars of the producer. There was a day-to-day control more or less by the stoker, and in the process we reduced the cost of gas in the holder at Bude by about 3d. a therm. We have extended that to some of our bigger stations and even made provision for it at one of the major stations at Bath, although we have not had to use it with the mild weather of last winter.

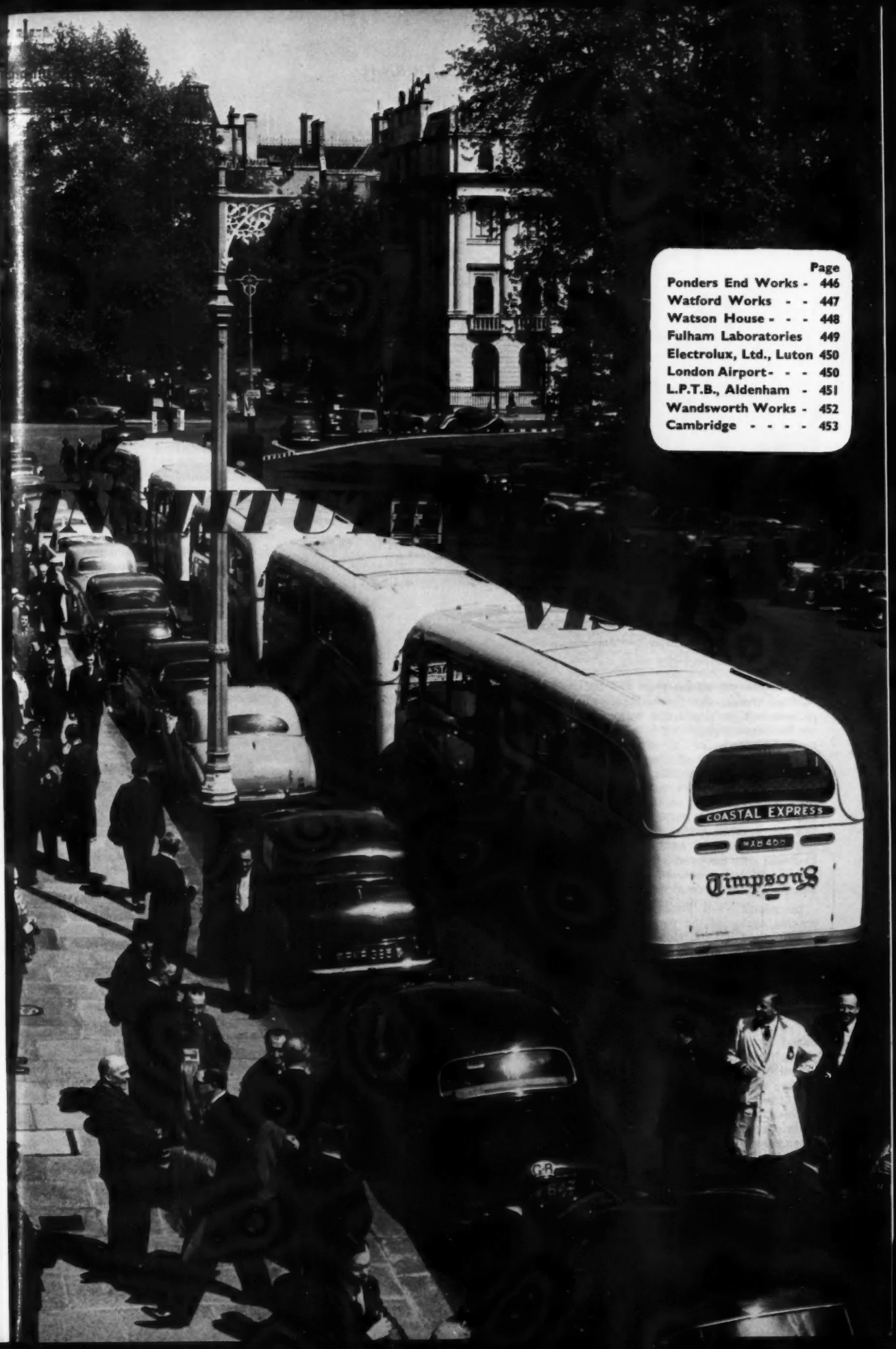
'I should like to remind one or two of the speakers that although this is an experimental plant at Gloucester, it is operational, and we do rely on the output from all these new plants for next winter's demand for gas. Perhaps some of our controls are over-elaborate, but as we were breaking new ground we felt that it was better to err on the side of safety than to take any chances, and I can assure you all that there will be technical supervision by shift engineers or senior technical assistants the whole of the twenty-four hours. The works looks more like an oil refinery than a gasworks, and I think that if you were to see it you would appreciate that we could not leave it to the tender mercies of a foreman.

'I was glad that Mr. Prigg raised the question of combustion characteristics. We did a lot of work on this as a result of the paper which he mentioned, and Woodall-Duckham's had a long investigation into it, and as a result we dropped producer gas out of our calculations altogether. We have checked up on all the likely mixtures that we are going to have, and in no case do we find that there is any indication of unsuitability of the mixture. Fortunately, the one which is most suspect, the Gaz Intégrale-Hall mixture, is only in use during the peak of the winter, when it becomes a relatively small proportion of the total.

'I have no information yet about the smell of the mixed gas, but we will let you know something more about that when we have got some to smell!

'Dr. Haffner raised the question of carbon in the Koppers-Hasche. We have had no trouble whatever with the deposition of this in the tiles themselves. Any carbon which has been deposited there has been burnt off during the following blow. We are getting a very small amount of carbon in the gas with which we are dealing quite simply on a small scale, so that we can recover it and form an estimate of what trouble it is going to cause; but fortunately, with our Jones plant experience, we do know how to deal with carbon if we make it.

'I quite agree with Mr. Clark that series operation is bound to result in low efficiency, but it is not our intention to operate in this manner except possibly for major peak-load periods.'



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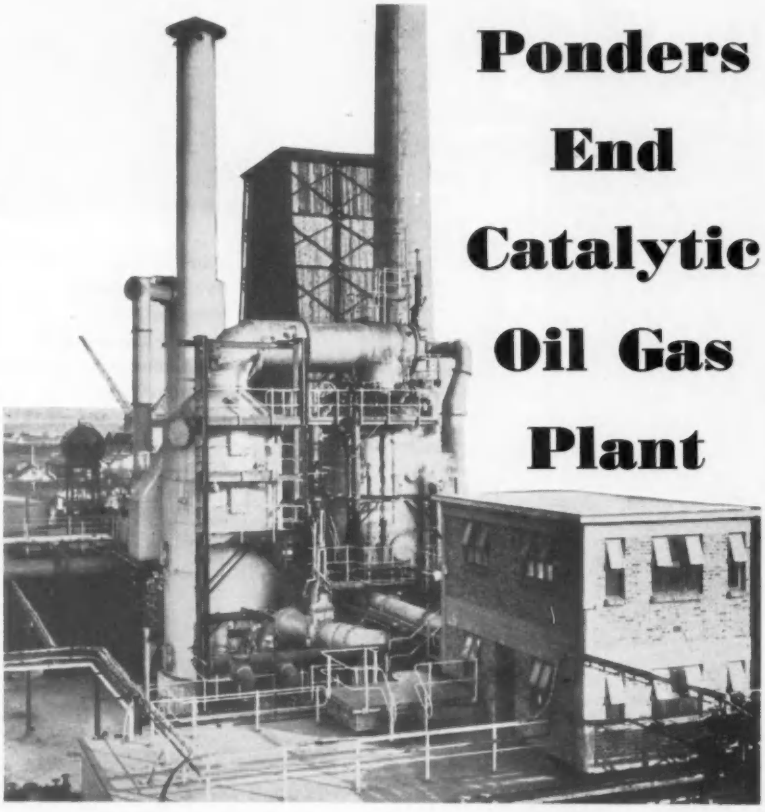
Ponders End Catalytic Oil Gas Plant



THE catalytic oil gas plant at Ponders End works, the first complete and independent gas production unit to work on the Segas process in this country, has been installed for a production of approximately 7.4 mill. cu.ft. of town gas per day at a calorific value of 515 B.Th.U. per cu.ft., although all ancillary plant has been sized in the expectation that an output of 8 mill. cu.ft. per day will be possible. The plant comprises two units each of half this capacity. One unit only has been installed to date; the second unit is now on order and site erection is due to commence soon.

In normal full load use the gas-making cycles of the two units will be synchronised out of step so as to attain the maximum efficiency in the use of auxiliary power, but it will be possible to operate either unit independently, at a lower power efficiency when only half output is required.

The process is cyclic, gas being produced by the decomposition of oil and steam in one direction followed by a period of combustion of carbon with air flowing in the opposite direction when the temperatures in the plant are restored. The efficiency of the process is improved by the use of chequered regenerators for pre-heating the steam and air.

The calorific value of the gas is determined in the main by the overall temperature in the catalyst bed. The higher the temperature, the lower the calorific value and vice versa. This is controlled by burning the deposited carbon with sufficient excess air to ensure that the temperatures in the catalyst bed rise by the end of each blow period only to the same level as at the end of the previous blow period. Whether or not this is being achieved at any given time is indicated by the record of the calorific value of the gas being produced.

The catalyst consists of magnesite with a small amount of lime fired in the form of rings. It is robust, very refractory, and unaffected by sulphur. The plant is designed to gasify heavy fuel oil.

Under certain conditions the temperature distribution may be such that the base of the reactor is too cool, resulting in the condensation of tar during the run. To avoid this a cycle can be used in which some of the air for combustion of carbon is passed through the reactor in the opposite direction from the normal. This is called 'backblast' and redistributes the temperatures in the plant. The backblast period of the cycle would normally follow the run and precede the forward blow. The backblast gases leave through a secondary stack above the washbox inlet.

The plant was designed and laid out so that the whole of the twin unit, to the end of the purification stage, can be worked by one operator and one helper on a shift basis.

When the second half of the twin plant is at work the operating cycles will be staggered. In this way one fan will blow both sets with little added steam consumption. The additional process steam required will enable a steam turbine generator to be installed. The operation of the whole twin plant, including exhausters and all auxiliaries will require approximately 170 kW.

The cyclic operation of the control valves is effected by a hydraulic controller of Power Gas—Lockheed design, which is provided with visible and audible alarms.

The main regulating valves on the plant can be operated from the control panel by means of a hand-operated hydraulic transmitter and a group assembly of selector valves, hand lever operated. Edgewise indicators are provided to indicate the relative opening of each valve so operated.

The control panel also houses the main instruments for the control of the plant. Process steam is measured by means of an indicating/recording/integrating steam flow meter, and air flow is measured by means of inclined gauges coupled to venturis. Also mounted on the panel is the flame eye indicating equipment for the burners on the waste heat boiler, and visual and audible alarm is given in the event of flame failure of either of these. Visual indication is also given in the event of failure of any of the circulating pumps.

The main control of the plant is by control of the calorific value of the gas. A sample of gas is taken from the Lymn washer outlet and purified in a duplicated train. The purified sample is taken through an automatically operated cock on the run gas valve which allows gas to pass only during the run and from there it goes to a small test holder in the control room which feeds a Sigma calorimeter mounted on the control panel.

Preventing Emulsion

The formation of emulsion in the separators is prevented by the introduction of Amine 220 which is added at the rate of approximately ½ gal. a day.

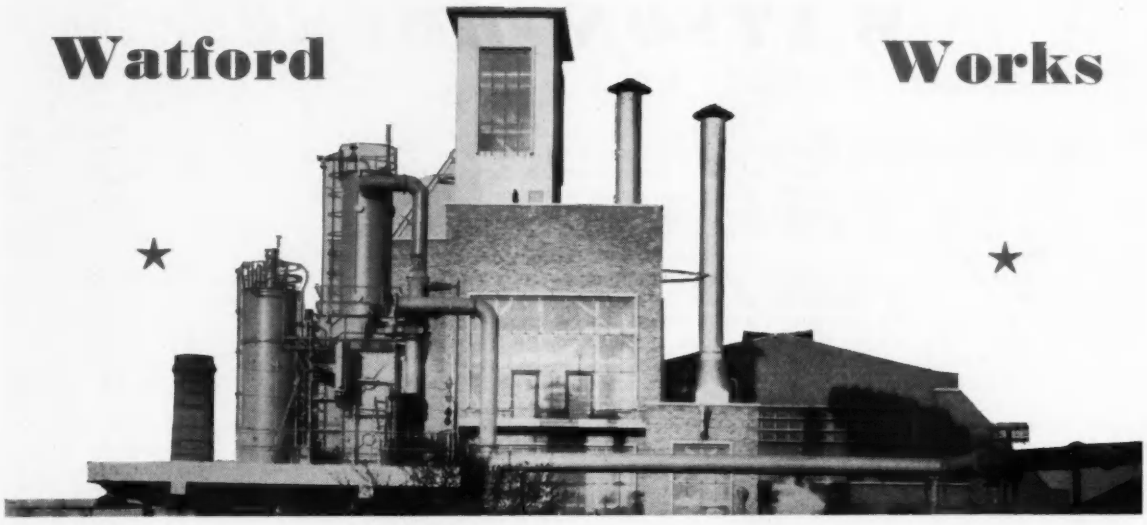
There is a heavy oil storage tank of 120,000 gal. capacity for the first half of the plant and there will be a further tank for the second half. These will store approximately seven days' requirements of heavy oil.

The tar produced amounts to approximately 8-10% of the make oil. A typical figure for free carbon is 15%. Overhead storage tanks are provided for reception of this tar and for loading it to road tankers. It is possible to sell the tar or to burn it in lieu of oil on the boiler and heating burners of the plant.

The relief holder has a capacity of 480,000 cu.ft. in two lifts, but only one lift is now used. The holder originally had 21 in. diameter inlet and outlet mains, placed close together, but as these were found to be too small, the two existing mains were coupled together to form an outlet and a new 30 in. diameter inlet main was provided.

The gas from the Segas plant contains about 300 grains of H_2S per 100 cu.ft. so that the requirements for oxide purification approximate to those for carburetted water gas.

Watford Works



Exterior of complete gasification plant.

THE carbonising plant of the Eastern Gas Board's Watford works, run almost entirely as a base load station integrated with other works in the Division via the North Watford holder station, consists of two retort houses containing two benches of six horizontal recuperative settings of eight retorts, each 24 in. by 16 in. by 23 ft. long.

Features worthy of note in No. 1 house are the recirculation of waste gases in the settings; flat topped producers with protected Hadfield steel lids; the suspended charging stopper; the method of control of coal charging by means of a 'second' clock developed by the works staff; the light design of stokers' tools; and a charging machine traverser.

Hot liquor is recirculated by means of electrically driven, self-priming pumps, while special provision is made for returning weak liquor brought down in the first sections of the condensers to the retort-house liquor recirculation system. The volume of return liquor is adjusted to keep the system in balance, a slight excess being constantly bled off to main liquor storage.

Producer Gas

Producer gas for dilution is manufactured in either a special plant constructed at the end of No. 2 retort house or in one of two C.W.G. plants.

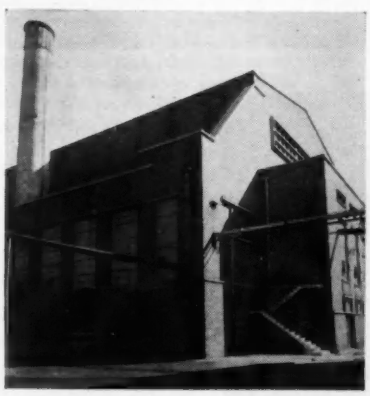
The condensing plant comprises two vertical tube multipass units each with a capacity of 2.5 mill. cu.ft. of gas a day arranged for series or parallel working. Gas connections allow for the reversal of flow. The steam driven Connersville exhausters provide low pressure process steam for the concentrated ammonia liquor plant and for heating the stokers' and yard workers' lobbies. Following the exhausters are two Livesey washers arranged in parallel, an electrostatic detarrer and two multifilm ammonia washers all with a capacity of 5.5 mill. cu.ft. of gas a day.

Benzole is recovered to the extent of about 2 gal. per ton of coal from coal gas only. The present benzole scrubber is shortly due for renewal.

The high cost of carburetted water gas and the desire to operate the works entirely as a base load station producing as much coke for sale as possible influenced the choice of a complete gasification plant using low rank coal at a cost of some 70% of the price charged for coke for water gas or producer gas manufacture and, at the same time, by reason of the higher calorific value of the complete gasification gas, increasing the daily output from the works from 5.5 mill. cu.ft. a day to about 7 mill. cu.ft. a day.

Complete Gasification

The complete gasification plant, designed and erected by the Power-Gas Corporation, Ltd., consists of a water gas generator with annular boiler and dry sealed mechanical grate. Superimposed on the generator is the retort which is divided into four segments by cross walls. Incorporated in the refractory blocks forming the retort are 16 flues with a further 12 in the cross walls. Following the generator is a carburettor, superheater, wash box and waste heat boiler. The annular and waste heat boilers work at 120 lb. per sq. in. pressure. Two steam turbine driven blowers provide the air required for the plant. The turbines exhausting to an accumulator, operating at between 10 and 15 lb. per sq. in., supply process steam for water gas production. The operation of the plant is carried out by a mechanical operator powered with Lockheed equipment.



Exterior of No. 1 retort house

The ancillary plant, erected on an elevated concrete structure, consists of a Lymm washer, a vertical Multipass condenser and a Multifilm ammonia washer, The electro detarrer, erected on the same platform, receives gas from the outlet of the exhausters which are separately housed beneath the platform. A set of five overhead cast iron purifiers 30 in. by 20 ft. by 10 ft. deep is used for the removal of hydrogen sulphide.

Operation

The plant operates on a 2½ or 3-minute cycle, the blow period occupying 40% of the cycle. Blow gases from the generator pass through the flues in the annular lining and cross walls to the carburettor, superheater and waste heat boiler, secondary and tertiary air being added to maintain temperatures. During the run period low pressure steam from the accumulator is superheated to about 850°C. in the upper half of the carburettor before entering the generator. The sensible heat from the water gas producer passes through the retort and effects the distillation of the coal. The mixture of water gas and distillation gas leaving the retort at 95° to 110°F. passes through the water sealed wash box to the ancillary plant and relief holder.

The plant, which has been in operation since December, 1956, has a nominal capacity of 2 mill. cu.ft. of gas a day at a calorific value of 320 B.Th.U. per cu.ft.

WATSON HOUSE

WATSON HOUSE, main gas utilisation research and development establishment of the gas industry and home of the Watson House Centre, spreads its laboratories, workshops, offices, and training centre over some 4½ acres in Townmead Road, Fulham.

For many, probably the most exciting part of Watson House is the exhibition which draws 3,000 visitors each year, and in visual and model form, tells the story of gas and coke, from the mine to the consumer. It also shows how the work of the laboratories leads to the more efficient and economical use of gas and coke.

There are ten main laboratories in which over 100 trained people are engaged in research and development, and the testing of appliances. All the laboratories play an important part in improving the service given by gas and coke appliances. They receive some 2,000 visitors from industry every year.

In the cooking laboratory all cookers are tested to British Standards of safety and performance. There is a special test kitchen where cookers and laundry appliances are thoroughly tried out in use. The laboratory works closely with the appliance manufacturers, exchanging advice and information.

There are still 5.5 mill. houses in Britain today without a hot water system. One of the major tasks of the water heating laboratory is the development of the cheapest efficient system of water heating by gas. In this laboratory, too, wash boilers and gas heated electric washing machines are tested and developed; thanks to the laboratory's work, their efficiency has been raised 25% since the war. Gas refrigerators are also tested.

Here, and in the aerodynamics laboratory, research goes on into the design of neater and simpler flues for gas water heaters and space heaters in the multi-storey buildings of today.

In our climate, warm rooms in winter at minimum cost depend on efficient and economical space heating appliances. In the Watson House space heating laboratory, research is always going on to evolve appliances that will give more comfort for the same or less cost. It tests all gas space heaters to stringent safety standards, including the guards. In co-operation with the water heating laboratory, the space heating laboratory conducts research into flue and ventilation problems.

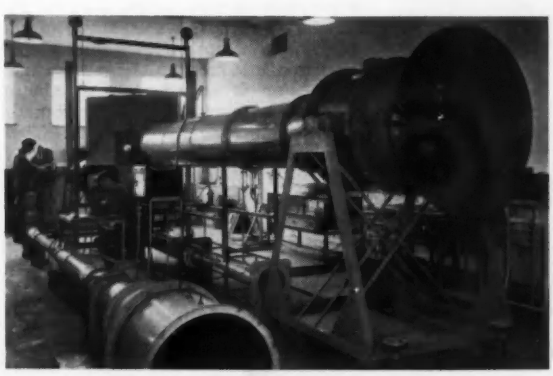
Research work in the coke laboratory has assumed added importance with the passing of the Clean Air Act. Work is concentrated on the easy lighting and burning qualities of coke, its moisture content and its sizing. Development of future coke fires and boilers, including combined gas and coke models, and the testing of coke appliances are other aspects of its work.

In the general laboratory the basic problems of burning gas are studied. New types of gas, such as natural gas or gas from oil make this research work specially topical. The general laboratory is on service to all the specialised laboratories.

Standards of construction and workmanship of appliances on test in other laboratories are examined in the mechanical laboratory. Other important activities are the development of tools and gas carrying components, and the sample testing of appliances delivered for sale by manufacturers and discussion at works to see that standards are being kept up and that appliances conform to the original approved sample.

The industrial laboratory deals with the 4,000 or so uses of gas in industry, ranging from salmon and sausage smoking to the firing of pottery, from surgical instrument sterilisers to the heating of chemical plant. Special equipment often has to be developed to meet the needs of individual consumers. In the aerodynamics laboratory flue terminals are tested and improved and developed. Ventilators are also evolved and assessed.

Equipment too large for other laboratories—central heating boilers, factory heaters, dish washing machines and café boilers—is tested in the large appliance laboratory; while requirements for the accuracy and effective life of meters are assessed in the meter laboratory.



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Above, the exhibition hall; left, the aerodynamics laboratory; right, the large appliance laboratory.

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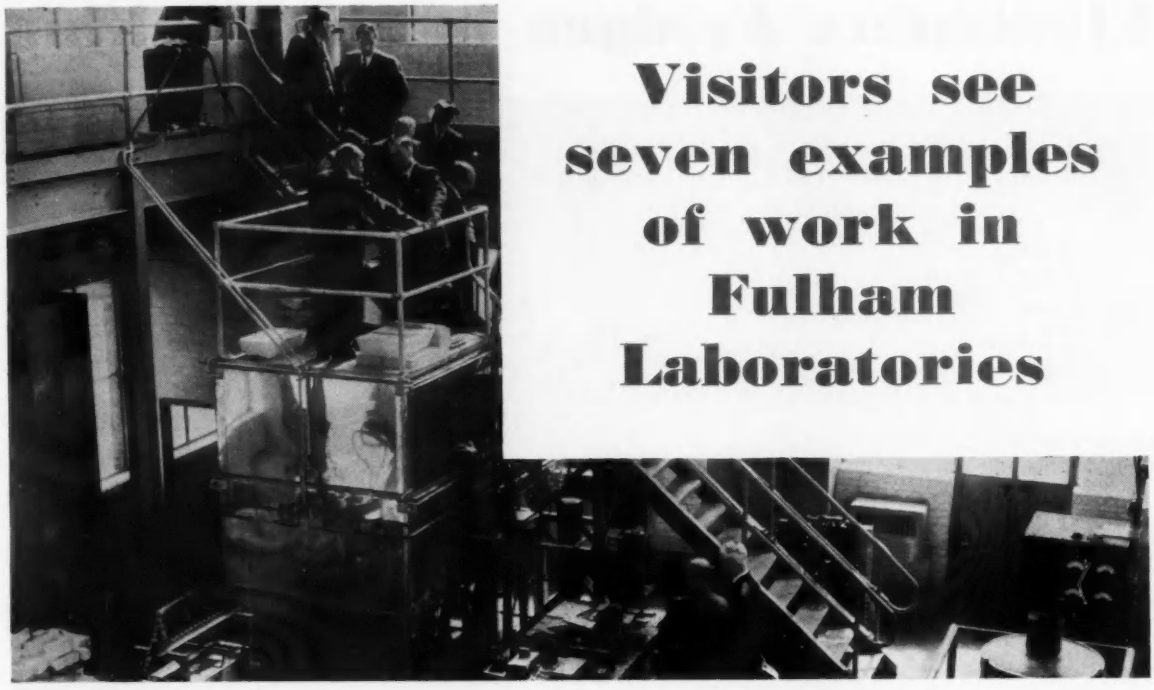


Visitors see seven examples of work in Fulham Laboratories

SEVEN examples of the work in progress at the Fulham Laboratories, administered by the North Thames Board as part of the Gas Council's London Research Station, were shown to the visitors. In No. 1 laboratory a demonstration was given of analysis by vapour-phase chromatography, an important aid to chemical research and control, providing a means for accurate and speedy analysis of complex mixtures of gases and vapours.

A small quantity of the sample to be analysed is mixed with a carrier gas, and enters a packed column which contains either a granular adsorbent or an inert filler wetted with a carefully chosen liquid. By repeated stages of adsorption and desorption, or by partition, the mixture is resolved into its components and these arrive separately at the column outlet.

Spectrography

In No. 2 laboratory, spectrographic methods and equipment were demonstrated. Many chemical substances can be identified and estimated by spectrographic methods, which comprise emission spectra, depending on characteristic lines emitted at a suitable high temperature; and absorption spectra, depending on absorption by individual compounds of radiation at characteristic wave lengths.

Research into the identification and isolation of micro-organisms was being carried out in laboratory No. 3. The biological oxidation of gasworks effluents in the absence of sewage has so far been carried out largely with mixed cultures. The various organisms present are now being isolated and are being grown in pure culture for detailed examination.

In No. 4 laboratory, the removal of hydrogen sulphide by liquid reagents was demonstrated. Processes capable of purifying gas to the statutory requirements by means of liquid reagents are being studied, a start being made with gases of a kind which will be available from the reforming of gaseous or distillate hydrocarbons which have a relatively low content of hydrogen sulphide.

Flaking of Refractories

It is already clear that no method of liquid purification can yet offer much economic margin over dry purification, and very careful design of the plant for such a process will therefore be necessary.

Investigation into the flaking of refractories in continuous vertical retorts was to be seen in No. 5 laboratory. The continuous vertical retort has a high thermal efficiency, and the working conditions are good. It has, however, the disadvantage that when the carbon scurf which accumulates on the surface of the silica refractory is burned off, large flakes of the silica are torn away with the scurf.

As a result of full-scale trials of impermeable materials it is evident that refractories of low permeability to gases are most likely to resist flaking. The impermeable materials employed to establish this fact are far too costly to use in practice. Work is therefore being carried out on the production of refractory materials with very low permeabilities, and on the glazing of conventional refractories so as to prevent deposition of the carbon within the brick.

In No. 6 laboratory, biological oxidation of effluents in packed towers was being studied. Experiments are being made on the oxidation of spent liquor by means of bacteria and other organisms. Purification will take place in the absence of sewage and may be carried out either in tanks or in packed towers. In the latter system the effluent is recirculated at a rate sufficient to ensure good wetting of the packing and air is blown in from the base of the tower.

Finally, in No. 7 laboratory, methods used in efficiency tests on full-scale plant were being investigated. This laboratory is the headquarters of a group which carries out investigations on the performance and development of carbonising and gasification plants.

Steam Measurement

In testing cyclic processes, such as water-gas plant, the Gaz Intégrale system, the Onia-Gegi, and the Segas processes, it is necessary to collect samples of the gases produced at several points during the various phases of the operating cycle, and electrically driven sampling apparatus controlled by the operation of the plant has been developed for this purpose.

A major item in the preparation of complete thermal balances for processes of this type is the measurement of steam quantities, but the rates of steam production and utilisation may vary so rapidly that commercial steam meters are generally incapable of following the rapid changes that occur.

A continuously-integrating flow meter which has been developed in No. 7 laboratory is capable of integrating a flow which changes from zero to maximum in 3 seconds, and further development is possible.

Electrolux Fridges in the Making

View of the refrigerator assembly line.

THE Electrolux, Ltd., refrigerator factory at Luton consists of two main sections: In one the actual refrigerating elements are constructed, while in the second, the cabinets are made and the finished product assembled.

The elements, which consist of a boiler, heat extractor, and cooling unit, are constructed throughout of mild steel pipe bent to form coils and equipped, where needed, with cooling fins to assist the dissipation of heat. The refrigerating medium is a solution of ammonia in water and hydrogen under pressure to aid evaporation and heat absorption of the ammonia gas.

The different parts of the element are all welded by oxy-acetylene and the whole element, when completed, is tested for leaks under air pressure and finally, after filling with ammonia and hydrogen, by wrapping every joint with a rag dipped in a solution of phenolphthalein which will detect the presence of ammonia by turning a characteristic purple colour.

In all cases the tubes are bent cold and up-to-date machines are employed for doing this. With few exceptions these are electrically driven and demand the minimum of effort from the operator. Some of these machines are of Swedish origin, since there is a constant exchange of ideas between the parent company in Sweden and the English subsidiary.

The output of the factory is about 200,000 refrigerators a year, of which roughly half are gas operated.

Ladies visit London Airport

Pictured here is part of the terminal buildings seen by the ladies when they visited London Airport.

Overhauling London's Buses

'THE world's largest and most modern factory for the overhaul and repair of a fleet of motorbuses' is how London Transport describe the Aldenham works on the Watford By-Pass, which some Institution members visited.

The works occupy a site about 2,550 ft. by 1,000 ft., the main factory consisting of a large block, roughly rectangular, about 1,500 ft. by 500 ft., with 16 acres of usable space under cover. Around this are grouped ancillary buildings, including a canteen catering for 1,400 at each sitting.

At intervals the buses and coaches are taken out of service for a series of inspections of increasing intensity and the making of adjustments and repairs. Conditions of service are more severe in the central than in the country area.

Periodic Inspections

Apart from nightly cleaning and rectification of complaints by the driver and conductor, other inspections range from a light three-weekly inspection during slack working periods to comprehensive overhauls every 48 weeks.

In addition, at intervals of a few years, each bus is brought into the works for a complete and detailed examination. The vehicle is repainted after repairs, and is sent out again in new condition.

Body and chassis are separated and overhauled independently; overhauled bodies and chassis are then reassembled into complete vehicles—within each of certain main types any body can be mounted on any chassis.

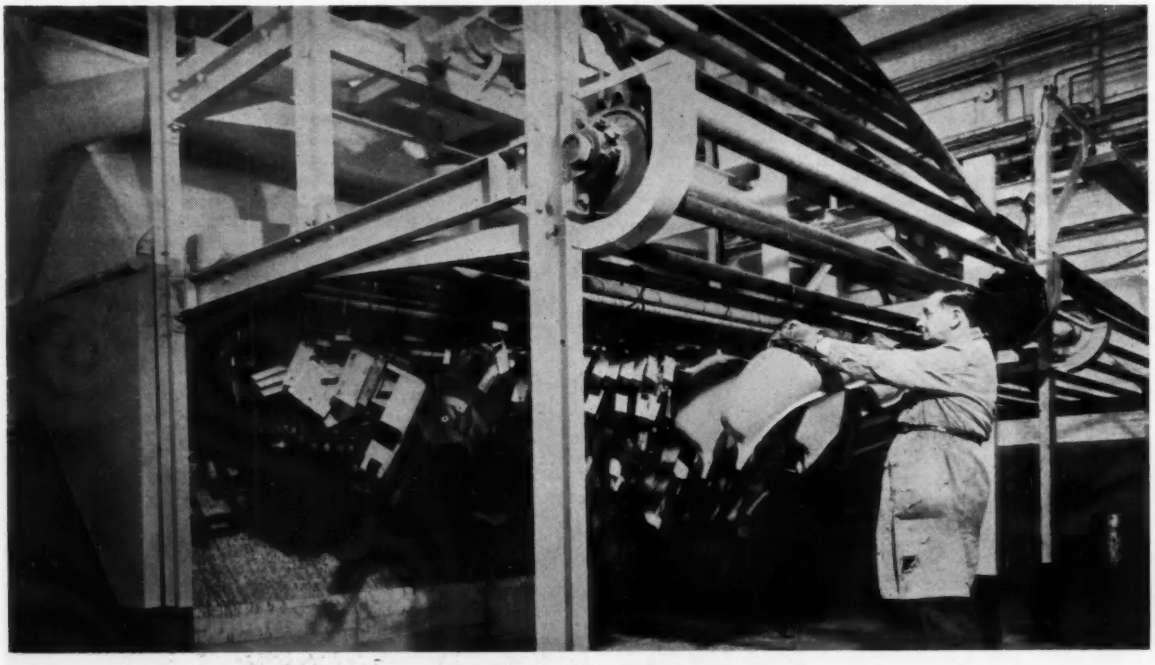
General view of factory and staff and canteen block from south-east.

Similarly, all the mechanical and electrical units such as engines, transmissions and the like, are standardised and their component parts interchangeable.

Of special interest are the paint shops. After passing through the preparation shop, exterior painting of the vehicle is carried out on a conveyor by spraying. The 220-yard long conveyor, which can accommodate 15 buses at a time, is not continuously moving, but moves up one body pitch approximately every hour. Windows are masked by instantaneously attachable plates, and spraying is carried out in special booths. The working platforms on each side of the bus are motorised and can readily be lifted to any level.

The booth doors are shut during spraying, as the cabinets are provided with filtered air at closely controlled temperature to avoid damage to the paint from dust and to give the minimum possible drying time. The motion of the air is downwards to carry off fumes from the sprayer. Air scrubbers remove surplus paint spray before the air is discharged.

For the colour a two-coat wet-on-wet process is used, followed by three stages of air-drying at shop temperature, in the course of which transfers are fixed and certain touching-in carried out. Two coats of varnish are applied similarly, but in this case drying is more difficult; after each coat the newly-varnished vehicle passes in three stages through a drying oven, operating at a temperature of 130°F.



Stove enamelling—entry to gas-fired baking oven.

Wandsworth Works

Tower purifier installation.

ESTABLISHED in 1834, the South Eastern Gas Board's Wandsworth works now occupies 28 acres and can produce 33 mill. cu.ft. of gas per day. A fifth carburetted water gas plant, now being installed, will increase the capacity to 37 mill. cu.ft.

Some 750,000 tons of coal are delivered each year by sea-going colliers owned and managed by the Board. These ships carry a cargo of some 2,800 tons of coal and have to pass under the 17 bridges which span the river below Wandsworth works.

The jetty is a reinforced concrete structure erected almost in mid-stream. The handling plant consists of two 10-ton hydraulically-operated travelling cranes each capable of discharging 300 tons of coal per hour. The coal is unloaded from the ships into hoppers whence it is carried by two 48-in. belt conveyors to a steel bunker on the shore. The hoppers on the jetty are also fitted with chutes by which the coal is fed into 650-ton barges.

Four Installations

There are now four installations of intermittent vertical chambers. These units contain a total of 144 chambers and carbonise a total of 950 tons of coal per day. All units are operated on a 12-hour carbonising cycle and a quantity of steam not exceeding 3% of the weight of coal charge is admitted during the last hour of the carbonising period. The two most recent installations have been provided with external step grate producers.

There are 24 horizontal settings, of which 18 are provided with the normal type of D section retort 24 in. by 16 in. by 23 ft. The remaining six settings have recently been rebuilt and each has been provided with nine horizontal chambers arranged in three vertical rows.

The C.W.G. plant comprises four units, having a total capacity of 12 mill. cu.ft. of gas per day. The last two units installed each produce 4 mill. cu.ft. of gas per day and are automatic in operation, employing the oil-hydraulic system. A fifth set of 4 mill. cu.ft. per day, which is under construction, will be equipped for gasifying either gas oil or heavy oil.

Five of the six carbonising units are served by No. 1 exhauster house, the gas streams being led to a reception box where a vacuum of 8 in. W.G. is maintained. The pressure conditions are regulated by governors situated on the collecting mains of each carbonising unit.

The high calorific value coal gas is diluted by the addition of blue water gas or producer gas. The quantity of producer gas added is adjusted by the control room attendant by hand-operated distant control valves.

The calorimeter room in which are installed six Fairweather recording calorimeters, is designed for thermostatic control of the air temperature and also of the temperature of the water used in the calorimeters. The equipment includes a gravitometer which records continuously the specific gravity of the gas being distributed.

Coal gas leaving the exhausters passes through a recently reconstructed scrubber yard which has been laid out in two parallel streams each consisting of secondary condensers, electro detarrers and static ammonia washers.

Carburetted water gas leaving the plant exhausters passes through electro detarrers and static naphthalene washers before entering the dry purification plant.

Tower Purifiers

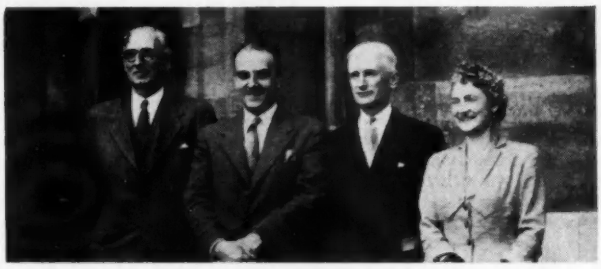
An existing installation of 18 rectangular boxes was augmented in 1938 by a set of tower purifiers—the first of its kind in this country. A feature of the plant is the electric crane which operates on a reinforced concrete structure and is used to raise the containers, each weighing about 35 tons when loaded with oxide.

Benzole recovery plant was installed in 1934 and is capable of recovering 3,000 gal. per day of 'once-run' benzole. The concentration of ammoniacal liquor is effected in two automatically-operated plants adequate to deal with the whole production of liquor and giving 36 to 40 tons of 20% ammonia concentrate per day.

Nos. 1, 2 and 3 coke plants are equipped with the vibratory and the balanced reciprocating type of screen and are capable of screening about 100 tons of coke per hour. A feature of the No. 2 plant is the system of band conveyors which enables all under-size coke recovered from the final bagging screens to be returned to the screening plant.

Coaling jetty.

University City



CAN anyone remember when the weather *was* bad for Institution Week? Last week, except for a brief shower which hurried people into the Thursday session, it was perfect; and for the large party who visited the University City of Cambridge, the colleges backs and gardens looked perfection.

The majority went by train from London, whereafter motor coaches which appeared punctually at all strategic points guaranteed unflagging feet during the visits to four or five colleges. Once again it is a pleasure to pay tribute to those who organised the details—the small and highly efficient team from Grosvenor Crescent assisted by the Cambridge undertaking.

Luncheon was at the University Arms Hotel; the occasion being honoured by the presence of the Mayor and Mayoress. Also at the top table were Mr. and Mrs. Dyde, Dame Vera Laughton Mathews, and Signor Boselli, President of the International Gas Union.

In the afternoon some continued college visits, others toured the countryside; but all gathered for tea at Pembroke, the President's own College, whose Master welcomed the party.

Top and lower pictures: *Groups pose for the camera at St. John's and Tr'nity Colleges.* **Right, above:** *The President and Lady Jones with Dr. Braunholtz and Mr. R. C. Wardell, Chairman of the Eastern Section of the Institution.* **Right, below:** *G. E. Anderson Newcastle), W. M. Gledhill (President, Scottish Association), Mrs. Melvin, Mr. Duncan Melvin (Junior Vice-President of the Institution).*

Abstract of I.G.E. Communication 505

Development of Catering Appliances

By E. W. B. DUNNING, B.Sc., M.Inst.Gas E., A.R.I.C.,
OFFICER-IN-CHARGE, COOKING LABORATORY,
WATSON HOUSE, GAS COUNCIL.

IN the last 15 to 20 years, the eating habits of the British public have changed considerably and a very large proportion of the population now has at least one meal a day in some type of catering establishment. To equip these establishments, about 60 manufacturers make over 1,000 different types and sizes of gas catering appliances. About 50,000 appliances are sold per annum, some by the gas boards, but most by the manufacturers themselves, or by their agents. By comparison, 500,000 to 750,000 domestic gas cookers, made by a dozen manufacturers and in 60 different types and sizes, are sold annually, almost entirely through the gas boards.

British Standard 1250 ('Domestic Appliances Burning Town Gas') was published in 1946, but it was not until 1948, at the suggestion of the Ministry of Education, that a Committee, which consisted of representatives of users, manufacturers and gas boards, and of which the author was Chairman, was appointed to draw up a British Standard for gas catering appliances. The tests finally agreed were based on those developed over the years by the Watson House Laboratories, and included the experience gained through the application of B.S. 1250 to domestic appliances.

In 1954, B.S. 2512 was published, and since then, due to the helpful co-operation of the appliance manufacturers, sufficient appliances have been submitted for test to enable a Gas Council List of Tested and Approved Gas Catering Appliances to be published; at present, it contains the names of 500 appliances. This is supplemented every three months by an additional list of appliances approved during that period; and the entire list will be re-issued every year.

About 300 mill. meals are served every week in catering establishments, of which about 35% are 'main meals,' and the rest teas and snacks. These are served in about 250,000 establishments, including restaurants, teashops, cafés, hotels, boarding-houses, works canteens, schools and hospitals. The proportion of these establishments using gas as the main cooking fuel is over 90%.

The most spectacular improvements are in the design of new types of appliance, although the greatest amount of development has been in the improvement of detail as a result of testing to the new British Standard. Since the Standard has only been in existence for a short time, most appliances examined have, of course, been designed and manufactured without reference to it. The Watson House Centre policy is not only to test appliances, but to advise how to improve them so that they can reach the required standard and higher.

Three Types of Tests

Tests fall into three categories: safety (combustion, surface temperatures), performance (cooking quality, thermal efficiency), and durability (enamel and other finishes, screw threads, materials and workmanship).

The principles of design for satisfactory combustion set down many years ago still hold good—sufficient air inlets at the right place, adequate combustion space, and adequate flue outlets. The provision of a gas pressure governor, now universal for domestic cookers, is becoming more general with catering appliances; there is little extra cost in using small governors built into individual appliances as compared with large service governors at the meter. The fitting of a gas governor allows the use of fixed injectors or jets, and these must be correctly sized for the particular Wobbe Number group on which the appliance is intended to operate.

Practically all appliances are designed so that they can be operated without any special precautions for avoiding fire risks, and the surface temperatures of taps and handles are tested to check that they are sufficiently cool to operate by hand. The employment of more semi-skilled operators in the kitchen is making is more essential than ever that operation shall be simple and foolproof. The avoidance of any possibility of an explosion hazard, by care in design, is to be preferred to the provision of safety controls.

The popularity of gas-fired catering appliances rests largely on their speed and flexibility. The provision of higher input rates without reduction in thermal efficiency is the aim of the designer. Any improvement in thermal efficiency can easily be offset by the waste of gas, and particularly is this so if the thermal input is increased to give greater speed. Automatic ignition reduces this waste as it encourages the user to turn off the gas when it is not required, especially if the appliance has a low thermal capacity so that the heating-up period is short. A continuously burning pilot is the most usual igniter, where one is fitted, and the more recent designs incorporate flame-failure protection where there is an explosion hazard. Recent developments in filtering the pilot gas on domestic water heaters, and in electrical ignition as applied to domestic cookers should be applied to catering equipment, and American experience in this field should be examined.

Benefits of B.S. 2512

It is encouraging to note that, since British Standard 2512 has been the basis of testing, the general performance standard, particularly in ovens, has risen considerably, and several of the newer catering appliances can be judged on their merits to give performances as satisfactory as do those for domestic use.

Probably the greatest improvement that has taken place as the result of testing to B.S. 2512 has been in the use of correct gas and water fittings and in ease of maintenance. Greater care is now being taken in the calibration of thermostats and thermometers. The average number of mechanical design improvements suggested to manufacturers has been 14 per appliance examined. All these lead to greater reliability and prevent a reduction in performance with age. The mechanical strength of the equipment must also be sufficient to stand up to the heavy use and abuse it will receive in many kitchens. Provision should be made for bolting down equipment with heavy doors, or constant use may cause the gas supply pipe to be strained.

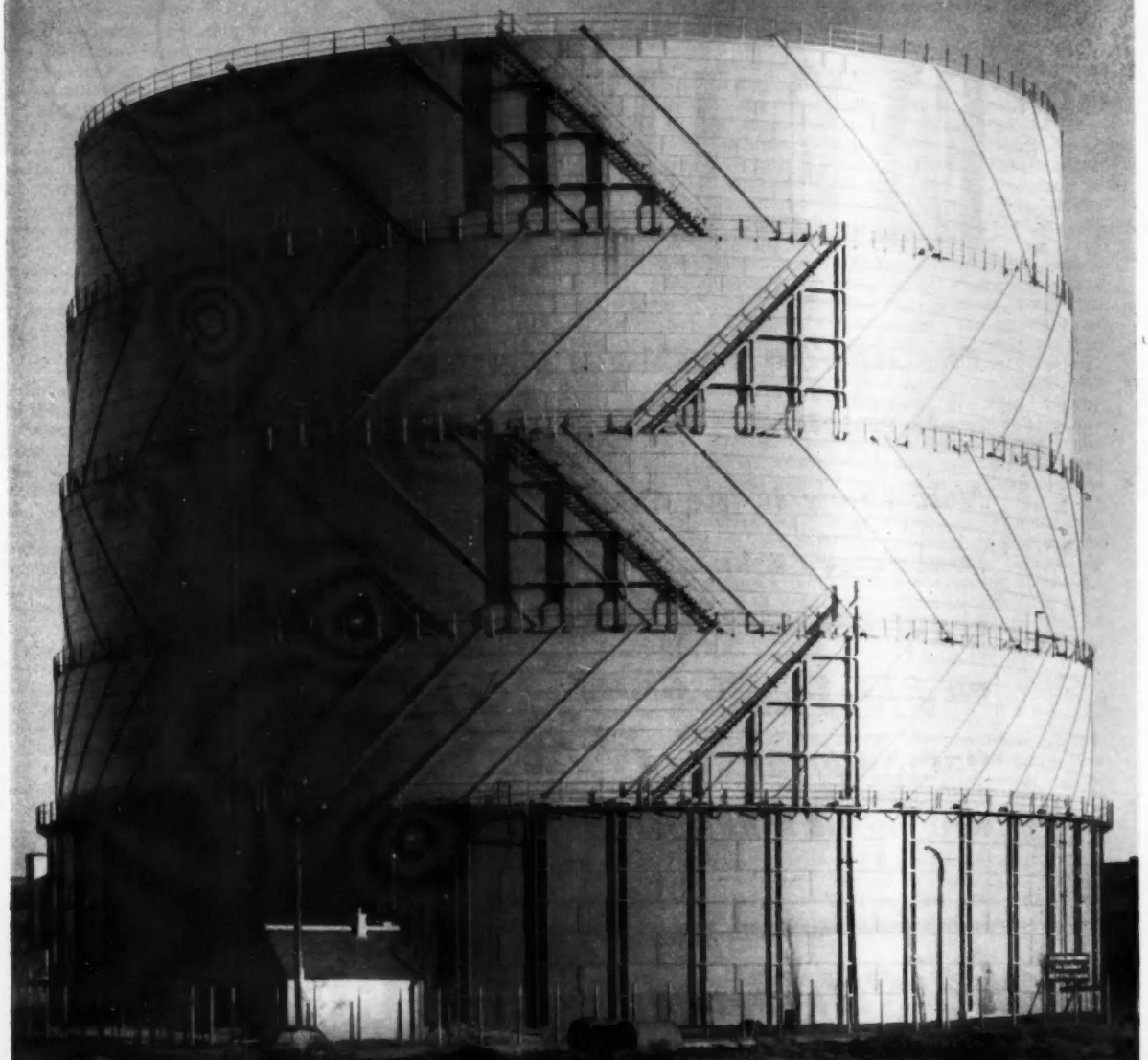
Stainless steel, usual in America, appears to be the most satisfactory material for making catering equipment, but its high cost prevents its general application in Britain; it also needs some contrast, or the result is too dazzling. Experience gained in the development of satisfactory vitreous-enamel and plated finishes for domestic appliances is now being applied to the more severe conditions obtaining with catering appliances. While many makers supply suits of equipment in the same enamel finish, the specialised nature of some appliances makes it necessary for those of different manufacture to be fitted in one and the same kitchen. It would be advantageous if the finishes could be standardised.

Design for ease of cleaning is essential. Controls, such as thermostats, relay valves and governors, are increasingly housed within the bodies of appliances, and ledges and crevices are avoided, so that clean smooth lines are becoming more usual and cleaning is simplified. The butting of ranges to avoid dirt traps is usual, but only a few makers design other appliances so that they can be grouped together, although this is common practice on the Continent. The forward-venting flue permits fitting an appliance flush with a wall and eliminates a serious dirt trap.

3 MILL Cu. Ft. CAPACITY

SPIRALLY GUIDED GAS HOLDER AND STEEL TANK

AT EDINBURGH FOR THE SCOTTISH GAS BOARD



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With the open-type boiling-plate, it has been shown that the increase in size of test vessel with heat input gives a reasonably constant thermal efficiency for all sizes of burner. Although the B.S. limit is 40%, two-thirds of the burners tested gave an efficiency of over 45%.

Regarding the closed type of boiling-plate, the latest development at Watson House has been the use of 'Hypact' secondary aerated jets made of steel, with an orifice plate of heat-resisting steel. The flame produced is flat and roughly triangular in shape. The burner, although originally designed for firing from the front, is now placed at the back and is directed on to a heat-resisting metal plate, the bright glow of which is reflected through the bullseye opening. The rear firing allows the flue gases to travel to the front of the hotplate and then back to the flue, giving a useful hot region at the front. Although a rating of 60,000 B.Th.U. per hour is possible, many users might be satisfied with lower ratings, which, although not as fast in operation, result in less waste of gas if left on inadvertently.

The 'Hypact' makes more noise than the multi-port burner, although this can be reduced by fitting larger jets to work at a lower pressure. This noise would, however, be an advantage so far as waste of gas is concerned; the user is more likely to turn off an appliance after use if he is audibly reminded that it is alight. This type of burner has the high turndown range of all non-aerated jets: the three burners can be turned down to a total of 1 cu.ft. per hour, which makes the provision of a separate pilot unnecessary. The design may be cheaper than alternative ones and certainly will require less frequent maintenance.

Closed-top Boiling Plate

Some chefs use the closed-top boiling plate for direct cooking by placing the raw food on the plate. Steaks, hamburgers, muffins, crumpets and drop scones can be cooked in this way. It is, however, more satisfactory to use plates designed for the purpose. Finning of the underside of the plate increases the efficiency, and correct disposition of the burners allows the top to be evenly heated.

Originally, completely externally heated ovens based on the old coal-fired ranges were used by chefs, but, like electric and solid-fuel ovens, unless these were well ventilated there was a tendency to give a braised or pot-roasted rather than a typical roasted joint. The design now used for the heavier type of oven consists of an open-top box with burners placed under the floor of the oven; the hot gases pass up behind the shelf runners and enter the oven at the top, circulate downwards and finally pass out of the flue.

The type of oven mainly used by women cooks has two side burners arranged in a similar way to those in domestic ovens, where the products of combustion mix with the heated air and travel round the oven and out of a flue. Roasting ovens are of similar design, but larger.

The disadvantages of solid fuel have led to the development of heat storage cookers for use in hospital and other kitchens where a 24-hour service is required, but the narrowing of the gap between the price of gas and solid fuel now makes these cookers less attractive. Electric cookers have also been designed on the heat storage principle to reduce the loading on inadequate power lines, although the higher running consumption requires a very attractive tariff. The possibility of using gas for heat storage appliances has been suggested, but the only advantage would be if there were considerable waste of gas caused by leaving normal burners alight. With the heat storage cooker, the gas rate is fixed so that only by leaving the lids open can the heat be wasted; this would result in lack of heat for cooking, and the waste would be brought to light.

In a small industrial canteen serving mid-day meals only, a solid-fuel heat storage cooker was converted by the user to gas firing with a clock control giving a 12-hour heating period; this gave a saving of 10% in gas consumption over the original gas equipment, which, incidentally, was excessive to requirements and of old design. A redesigned heat storage block gave a greater saving, but the installation of a single-unit range of modern design showed a saving of 50% in gas consumption, and the flexibility of the gas range was far superior to that of the heat storage cooker.

Although pastry can be baked in general-purpose ovens, superior results can be obtained in special pastry ovens. These are of two mains designs—the type in which a number of tiers are heated by one system of burners so that the same temperature is obtained in each tier, and the type in which each tier is independently controlled. This second arrangement is more flexible, as different temperatures can be obtained in the different tiers, but the capital cost is somewhat higher. All pastry ovens appear to be of the externally heated type.

Separate Thermostats

A recent development has been the introduction of separate thermostats to control the top and bottom heat of each tier. Some American ovens, also, have separate thermostats controlling the top and bottom heat, and snap-acting thermostats are sometimes used. In a recent American Gas Association investigation, higher efficiencies were made possible by reduction of the air inlet or of the flue outlet. The provision of a gas—air premix, so that little or no secondary air was required, did not materially raise the efficiency, but the installation of a small fan to give forced circulation of gases considerably reduced the baking time. Research work at Watson House on forced circulation is proceeding. A French oven in which the top and bottom heat could be varied by a damper is another possible variation of design for consideration. Many Continental ovens also have a proving oven built into the unit.

The surface-combustion element can give increased radiant intensity with advantages for some kinds of grilling. The development of surface combustion units without compressed air has simplified the use of this principle. The possibility of poor combustion at very low turn-down rates has resulted in the development of cocks that spring past this vulnerable region. A front structure to reduce air dilution would give perhaps the highest efficiency of any type. The high temperatures obtained with the surface-combustion elements require care in design if flame travel through the perforations and lighting back is to be avoided. Perforated fireclay is the usual element, although heat-resisting metal mesh has been used on the Continent.

In order to produce even grilling it is necessary for the ends and particularly the corners of the radiating element to emit a larger amount of radiant heat, which can easily be arranged with variation in burner ports. While this makes it virtually impossible to turn half a grill off and get even grilling from the remaining half, it is possible to arrange a middle third so that even grilling is obtained when the end thirds are turned off.

Electric Contact Grill

A recent Continental introduction has been the electric contact grill, the so called infra-red grill. The latter is a misnomer, as all radiant gas grills cook by infra-red or radiant heat of long wavelength, whereas this electric grill cooks mainly by conduction. A comparison was made between the electric contact grill and the same appliance converted to gas firing by a similar method to that used in gas irons. Comparable cooking speeds were obtained, but it is likely that the gas version would be greater both in initial and running cost. A gas contact grill developed by a manufacturer was also shown to have a similar performance.

Some grills, have a heavy ribbed plate under the radiant surface on which meat can be placed. The plate, being heated by the radiant heat above, cooks the underside of the meat while the top is cooked from above. Although under-firing of this plate speeds up the cooking of the underside of meat, experiments have shown that this must be carefully regulated, otherwise it tends to cook the underside before the top. This type of grill has been shown to have the speed of cooking of the electric contact grill. The gas grill has the further advantage of being capable of cooking food of different thicknesses at the same time, such as chops and steaks, as well as tomatoes, mushrooms, etc., which would become damaged if pressed between heated plates on a contact grill.

Another type of grill developed some time ago cooks both sides of the food by radiant heat. The food is placed in a carrier between two radiant sources. A recent development using surface combustion allows the radiant surfaces to be used either horizontally or vertically, thus coverting the unit

into a general-purpose grill for both toasting and salamandering as well as for grilling.

The provision of fins or studs on the bases of the pans of fryers, in order to improve heat transfer, was an early gas industry development, and many pans are now of this type. Thermostatic control of the fat temperature is desirable, as it saves fuel and prevents overheating of fat, and also decomposition and risk of fire, which result from this. It is essential for the maximum heat input to be applied as soon as the food is inserted, as the insertion of a mass of raw fish or raw chipped potatoes cools the fat considerably; also, a large amount of heat is required at once to evaporate the water present. This can best be achieved by the use of a thermostat operating a relay valve giving snap action to keep the gas either full on or at maintenance rate. Table 1 shows how the output and efficiency is improved by fitting a relay valve to one design of fryer.

For heating viscous liquids that burn easily, such as porridge, custard and milk puddings, a jacketted pan is used that is similar to a double saucepan. One manufacturer has spread the heat over the bottom surface of a pan, which is intended to reduce the risk of burning thick liquids by giving the effect of a jacketted pan at less cost. In ordinary jacketted pans, water is generally used to transfer the heat from the hot gases to the inner jacket, but steam can be utilised equally effectively and is much more usual on the Continent.

Steamers

Steamers are used for steaming root vegetables and fish in open trays, and sponge and suet puddings in roll tins, basins or individual moulds. Although cheap, simple steamers can be hand-fed with water, it is usual to have an automatic supply through a cistern and ball valve.

Thermostatic control is generally supplied to prevent waste of gas by cutting down burners after steaming conditions have been reached. Initial conditions are similar to those obtained with fryers, in that a mass of cold food is placed in the oven on which the steam condenses, leaving a cool atmosphere that has to be reheated quickly. A thermostat controlling the burner through a relay valve gives a faster operation than a direct-acting thermostat, since the gas comes on fully when cold food is placed in the oven and so allows it rapidly to reach the correct temperature again.

Some steamers have their steam outlets open to the atmosphere. In other steamers, the steam outlet valve is loaded and a pressure slightly higher than atmospheric is obtained. Pressure up to ½ lb. per sq. in. only are used in order to avoid the necessity for heavy and therefore expensive construction. (The clause in the Factory Acts relating to pressure vessels does not apply at these pressures.)

A steamer not open to the atmosphere must be fitted with an anti-vacuum valve to allow air to enter the steamer if the pressure inside falls below that of the ambient atmosphere. This would occur if the gas were turned out and the door left shut when the compartment might be full of steam, which would condense and cause a partial vacuum, thus preventing the door from being opened against atmospheric pressure; in an extreme case, the wall could possibly collapse.

Although the gas rate is usually controlled by the temperature of the steam, it can also be regulated by the steam pressure. This pressure increases quickly with a small rise in temperature so that a more sensitive control is obtained. A thermostatically controlled vent is provided to prevent the pressurestat being operated by the initial expansion of the air in the compartment as it is heated, and to shut off the gas before the required temperature is reached. This vent remains open and releases the air pressure until the vapour issuing from it reaches the temperature of boiling water; the vent then shuts and the pressure increases until the pressurestat goes into operation and reduces the gas rate.

Swedish Development

A Swedish development consists of a high-pressure steaming oven (30 lb. per sq. in.), which increases the speed of cooking as does a domestic pressure cooker. Cooking is done at high pressure, and when completed the steam around the food disperses and browning is obtained by high-temperature radiation from electric elements. It is claimed that the weight loss is greatly reduced and the speed of cooking increased by this method. The initial cost of the oven is high due to the high pressure it has to withstand.

The best temperature at which to keep food hot is 170° to 190°F.: lower temperatures are unpalatable, and higher temperatures result in over-cooking. The humidity of the air surrounding the food is important, as the drying out of foods is detrimental both to their value and to the appearance of the dish. Insulated hotclosets are shown to be considerably more efficient than uninsulated ones. As with ovens and steamers, the B.Th.U. per cu.ft. of space increases rapidly as the size of the hotcloset decreases, and it is proposed that uninsulated hotclosets should have a maximum of 1,900/(∛volume) B.Th.U. per cu.ft. of space and that insulated hotclosets should be 75% of this, i.e., 1,400/(∛volume) B.Th.U. per cu.ft.

Bains Marie

The term bains marie was used originally to indicate a bath of hot water in which utensils containing food were placed to keep warm. Special utensils may be designed for this purpose. It is often convenient to combine the functions of a hotcloset and a bain marie. A recent development has been the air-heated bain marie. Filling with water and a steamy atmosphere in the kitchen are thus avoided, but accurate thermostatic control is necessary if overheating is to be avoided. The high thermal capacity of water and its maximum consistent boiling-point temperature makes it a useful and easily controlled medium for keeping food warm.

The introduction of cooked food that has been frozen rapidly and then stored for a long period has presented the difficult problem of quick and even thawing of the food, and then reheating it to eating temperature without further cooking. An early Watson House development for small quantities was a compact oven using natural convection. Further developments have been made in larger ovens.

Non-pressure Boilers

Continuous-flow non-pressure boilers can be over 70% efficient, and over half are over 65%. The pressure-type working at high temperatures cannot be as efficient and there is great difficulty in reaching the B.S. limit with the tubular heat exchanger, although with the finned heat exchanger the B.S. limit can be reached easily. It is being suggested that the limit should be reduced to 55% for this type. Bulk boilers show the greatest variations in efficiencies and, although the limit is 45%, an efficiency of almost 70% is possible. Perhaps the limit should be increased to 55%.

A new development in tea brewing is an appliance by which 4 gal. of tea are produced automatically from 4 oz. of tea leaf. All metallic parts are silver plated to prevent any tainting; the tea is brewed under pressure and when infused is transferred to glass-lined urns. Coffee is similarly infused at a lower temperature, and then given a double filtering.

Espresso Machines

The Italians have developed the Espresso coffee machine in which hot water under mechanical pressure is forced through finely ground coffee to give a fresh infusion for each cup. Espresso coffee bars that have sprung up in this country provide a market for this type of appliance, which is mainly heated by electricity with a gas booster. Considerable help has been given with the gas equipment, and it is hoped that this will lead to an approved all-gas model. At least one English manufacturer has developed equipment to produce the Espresso type of coffee, but without the mechanical pressure.

Labour shortage during and since the second world war has accelerated the pre-war tendency towards self service; this, together with the desire of the customer to see the food being cooked, has increased the amount of counter cooking. In America, much of the equipment for this purpose is gas-heated. Similar equipment, largely electric, has been developed on the Continent, where there is an even greater tendency towards eating out. When this type of establishment began to increase in this country there was an increase in the sale of electric equipment, as the gas-heated American designs were not available. This is unfortunate for the gas industry, not only because of the loss of gas load, but also the loss of the prestige and advertising value of appliances given where they are used within sight of the customer. Developments have, however, taken place with gas equipment and several makes of appliance are now available.

DISCUSSION

Mr. A. O. Russell (Chairman, Catering Equipment Manufacturers' Association): 'I should like first to thank and congratulate Mr. Dunning on his able paper. It sums up the work of many years on both sides of the industry—the manufacturing and the supply side.

'B.S. 2512 has been welcomed, but there is some confusion over the Ministry of Power's H.G.B.5, "Standard Specifications for Cooking Equipment," which has several points of difference. We can only hope that the Gas Council's "List of Tested and Approved Gas Catering Appliances" will provide the short answer for consumers who are trying to find out what they really require or are supposed to buy when all the testing is completed. It is not going so far as some of us would like.

'There is some danger in making equipment highly hygienic, streamlined, contemporary in design and indistinguishable from electric appliances. There is inconvenience in components being so enclosed that they are not easily accessible. The very fact that gas equipment can function almost indefinitely without actually breaking down tells against it when, through abuse and neglect, something has to be done, and tough excavation is necessary to replace a tap.

'Mr. Dunning's remarks on safety devices are particularly interesting. It is not enough to fit something and say it is 100% safe and foolproof. It might even be better to emphasise the dangers. The answer is not easy to find, but it should certainly include precautions against serious damage in the event of an explosion. Manufacturers are very seriously grappling with this problem.

'Dry-frying'

'About grillers, the popular French design heated from below has been very popular in France since long before the war. It is simply dry-frying. We tried this with the addition of top heat which was so effective that we abandoned the bottom heat altogether and found that by cooking by contact heat from below and radiant heat from above, a minute steak could be cooked in 50 seconds!

'There has probably been more talked and written about grilling than any other form of cooking, but it is still the simplest and easiest form. You can see what is happening all the time and stop it when it is finished. It is even simpler than boiling an egg.

'It is interesting to see how excellent are the results from the American Gas Association design of deep fat fryer. We made two small ones on these sloping-side lines before the war, as part of a large central range, and they were highly successful. We did not pursue it, however, as we found that there was no real objection in practice to heating the base as well, and the simplest, easiest-cleaned design gave excellent results in every way.

'For gas-heated boiling pans, manufacturers have for years had to choose between bower-barffed cast iron, which is cheap but has a rather short life, and stainless steel, which is not entirely satisfactory and is very expensive. Now, however, a die-casting of aluminium alloy produced specially for use with food, has proved entirely satisfactory over seven years for all materials except lemon juices: and even *that* one failure, after two years' use, may have been due to the high content of the preservative. I think the outside suffered.

'The heat transfer is more efficient than with cast iron, and the heat distribution is better than with stainless steel, the initial cost being very slighly more than cast iron. This has enabled pans of nearly 40 gal. capacity to be used efficiently on gas.

'On steaming ovens, there have been many attempts to provide consistent results with unskilled attendants. It seems to be generally agreed that the ideal steaming conditions are provided by about 3 lb. per sq. in. The next best is any constant supply of steam. The problem has been how to keep that supply going. A thermo-pressure-stat was designed before the war, which would only cut down the gas when both temperature and pressure were adequate, but the thermostatic bellows type of air release valve has enabled the pressure-stat itself to do the job, provided that one can be found to work consistently at a negligible or almost atmospheric pressure. The fact that Mr. Dunning has shown that the thermostat-controlled and the pressure-stat-controlled steaming ovens give equal performance is comforting, as I have not found a pressure-stat which would give the *practical* results we needed, under working conditions.'

Mr. A. V. Horsfall (West Midlands Gas Board): 'The author has again given us a paper to his customary high standard on a subject in which he is recognised and acknowledged as a leading authority. I would here like to pay a tribute and acknowledge my personal thanks to the generous assistance given by Mr. Dunning and his staff at Watson House to me in my capacity as Chairman of the Catering Panel.

'The author makes a comparison between the number of manufacturers producing catering and domestic gas appliances and from the figures quoted it might be thought that the profit margin on total sales possibly provides catering manufacturers with insufficient incentive to approach costly appliance design modifications with any real abounding enthusiasm.

Stimulus of Enthusiasts

'It says much for the stability and grasp of detail which the gas industry has in the catering trade that after many static years, manufacturers under the stimulus of enthusiasts like Mr. Dunning now recognise the inherent business possibilities arising from the need for both new and replacement equipment, that they are actively co-operating in new and costly development.

'The author mentions that gas serves over 90% of the catering establishments in this country. Because of the long and close association between the gas and catering industries, it is also probably true that of this 90%, some 60% continue to use equipment which has served too long and in many instances may be obsolete.

'Possibly arising from conditions of scarcity and the attraction to the manufacturers of more rapid economic improvement in fields other than heavy duty appliances, too many of these appliances have been patched and repaired beyond their efficiently useful life. There exists therefore a considerable field for new and replacement gas catering equipment, operating to the benefit of the hotelier and caterer, at increased efficiency and lower running cost, as indicated in Mr. Dunning's paper.

'In my view, much of this business lies in default because as an industry we have insufficient trained staff specialising in the catering trade and continue to rely upon holding and increasing this valuable business, with its excellent load factor, by using industrial representatives to cover catering almost as a poor-relation sideline.

More Specialists

'I would suggest the appointment of more catering specialists in area boards with an initial and detailed training under the guidance of Mr. Dunning at Watson House. I am glad to say that in the West Midlands we hope shortly to make such an appointment.

'On the question of ignition, I am yet to be convinced that any form of ignition other than the shielded permanent pilot offers acceptable advantages to the professional chef or cook, particularly in establishments where burners are frequently left lighted when serving no useful cooking purpose.

'Flame failure protection might, however, be more generally adopted for burners in enclosed or unsighted locations to overcome hazards, no matter how much past evidence fortunately proves accidents from such hazards to be of infrequent occurrence.

'On the question of boiling plate design, more attention could with advantage be given to hotplate height. It is very important where heavy and often awkward loads have to be lifted, placed and moved about on the hob. The same considerations as for domestic cookers do not apply, since heavy duty appliances are often fitted on isolated and island sites and do not have to match up in height to adjacent furniture as in domestic kitchens.

'I am intrigued by the author's statement that the type of oven mainly used by women cooks has two side burners. There can surely be no question of two-burner ovens being specially available for women cooks, but it may well be considered of some fascination that sex has now entered into ovens. On the other hand, two burners must bring more risk of blockage from spillage than one burner, and therefore there is some maintenance consideration.

'After all the remarkable work so ably undertaken over the years by the author and given that one oven burner can be as efficient as two, I am sure that the task of convincing the ladies that they may be wrong would be

undertaken by Mr. Dunning with both zest and even relish.

'My impression is that the success of the electric contact grill was short-lived and today has rebounded to the discredit of the electrical industry because of the contact grill's very poor cooking quality where its speed only served to dry out juices so essential to the flavour of cooked meats, especially steaks.

Unsatisfactory Appliance

'While it is interesting to learn that similar speed can be achieved with gas contact—or properly to describe the process conduction grilling—I hope we shall not be misled into imitating the mistakes of our competitors by marketing such an unsatisfactory appliance to the detriment of high quality and natural-flavoured cooking by the infra-red gas grill.

'One last word—the author points to the possibilities opening up to equipment manufacturers in the event of European interchange of trade without tariff barriers. Should this suggested state of affairs become fact, it is to be hoped that British equipment conforming to the high technical requirements in this country will successfully find an additional market and prove that not only British gas appliances but also the food cooked in them has a quality to delight the palate of our Continental friends.'

Dr. D. E. Klue (Assistant Chief Engineer, J. Lyons & Co., Ltd.): 'You will appreciate that I can only contribute to these proceedings by confining my remarks to the user's point of view.

'Mr. Dunning's paper covers its subject so completely as to embody the "users' needs and wishes," but I would like to emphasise his reference to automatic ignition. It seems to me that more consideration should be given by manufacturers of catering appliances to fitting automatic ignition, particularly to such burners as are not visible or not easily accessible; such automatic ignition must be foolproof either by mechanical procedure or by incorporating safety controls. For it would be a great advance and a considerable relief to caterers and their staff if the lighting of gas-fired catering appliances presented no more inconvenience or apprehension than does the action of switching on an electric light.

'I should also like to emphasise ease of cleaning and here both design and finish must play their part, for we must accept the fact that psychology plays a very large part, and the lighter shades of finish enable the results of cleaning to be seen.

'Some of you might be interested to learn that in a typical London teashop during a certain day in 1957, 3,816 customers entered the shop and 3,816 cups of tea or coffee were ordered. On the debit side should be noted 19,282 pieces of china and silver which had to be washed.'

Mr. J. Benham (Technical Director, Benham and Sons), who spoke next, said:

'I am afraid my comments will be comparatively minor ones. In the first place, it would be interesting to manufacturers to know the size of the catering load; that is, we know from what Mr. Dunning has told us the number of catering appliances sold, but what is the relative importance of the catering load from the gas consumption point of view to the gas boards, compared with the domestic load? We sometimes feel we are very much the naughty boys compared with domestic manufacturers who are so often held up against us from the design point of view.

'I do not think Mr. Dunning could expect me to agree that catering appliances are behind domestic appliances in design. If they are, it is obviously because the number of domestic appliances is so much larger than the number of catering appliances. In addition to the ten-to-one margin Mr. Dunning has mentioned, it must be remembered that substantially domestic appliances are one standard type. I do not mean design standard, but serving one standard purpose, whereas every kitchen dealing with the catering trade has a very wide range of appliances, so the balance is much more than ten to one against the catering appliances.

'Mention is also made of enclosing governors inside the casings of the appliances. We have never agreed with Mr. Dunning on this point. It seems to us that the appearance of the fitting may be improved by enclosing the governor, but you make the governor inevitably much more difficult to get at and you are not always free of trouble from the governor getting overheated.

'Mr. Dunning mentions the possibility of the import of foreign apparatus into this country and export from this country to certain countries abroad. Quite a lot of work could be done by Watson House which would be much appreciated by manufacturers in persuading some of the component makers to produce more standardised designs and ones specially made for catering rather than domestic appliances. A great many thermostats are obviously adaptations of those used on domestic appliances which have been the only type available for catering appliances, but are not the most useful type.

Steady Does It

'There are a number of proposals in the paper for alteration to the British Standard. I do urge that this should not be done too quickly. Continued modifications in apparatus which might be caused by changes of the standard must give many people the impression that their apparatus, which has only been in a few years, is out of date.

'The last thing I want to ask is whether Watson House are trying to do too much. It seems to me that possibly the situation could arise where the manufacturer could sit back and say all this work has been done and why should he do it? That is dangerous.

'Another aspect of the same matter is that it seems that we have not finished by having a British Standard, since we have received another publication called H.G.B. 5 only three years after the British Standard. Some of the specifications in H.G.B. 5 are out of date before they are published. When a manufacturer is expected to quote and either comply with the specification completely or else specify where he departs from it, it must have the effect of making him decide either to ignore it completely or else to base his design on something which he might consider is already considerably out of date.'

Mr. L. T. Minchin: 'I have a feeling that the industry is rather more complacent than it should be on the question of safety taps. We should call them taps now, I think—safety cocks and safety taps.

'The prevalent practice of using the drop fan type of cock seems to be going on. This is, however, a form of tap which can be turned up by a single blow of the hand or, indeed, a cuff can be caught in the cock so that it is turned on by accident. It is so important that the oven should not be turned on by accident that I do think more attention should be paid to designing a safety cock.

'Very few of the present types in use, and certainly not the drop fan cock, really qualify in my opinion for the title of safety.

Thermal Efficiency

'I feel rather sad to see 30, 40, and 50% given for thermal efficiency on boiling burners. The fault lies in the complete lack of any organised research into the fundamental principles of heat transfer from flames. This most important phenomenon of the reaction between a flame and a solid surface which is at the basis of so many applications of the gas industry and certainly the basis of a great many cooking applications is really not understood thoroughly.'

Mr. W. T. Lane (South Western Gas Board): 'There are some facts of outstanding interest in the introduction to the paper. These are contained in the second paragraph which I should like to quote:

> '"To equip these establishments, about 60 manufacturers make over 1,000 different types and sizes of gas catering appliances. About 50,000 appliances are sold per annum, some by the gas boards, but most by the manufacturers themselves, or by their agents. By comparison, 500,000 to 750,000 domestic gas cookers, made by a dozen manufacturers and in 60 different types and sizes, are sold annually, almost entirely through the gas boards."

'Multiplicity of types of appliances can never achieve any form of standardisation and therefore consequent development and design, and the irony of the situation is clearly shown in the passage that I have quoted.

'When the Gas Boards virtually control the sales of domestic appliances varieties are limited but, as we all know, there is advancement in design which acts separately as an incentive between competitive manufacturers.

'What is the position on the catering side? The major gas cooking appliances sold to-day, with possibly a few exceptions, are virtually the same as those appliances the design of which was pro-

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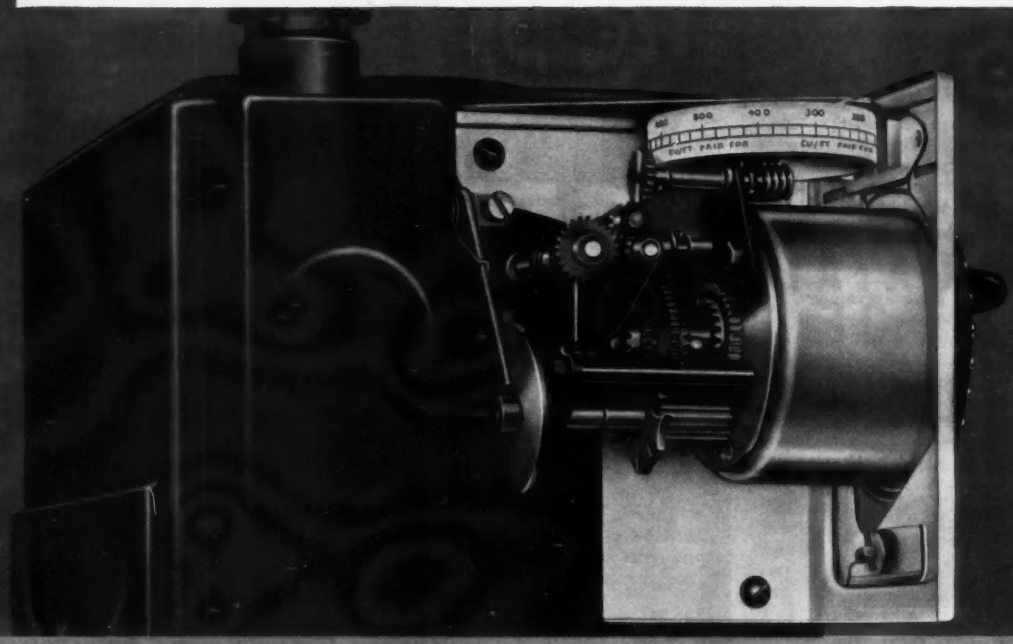

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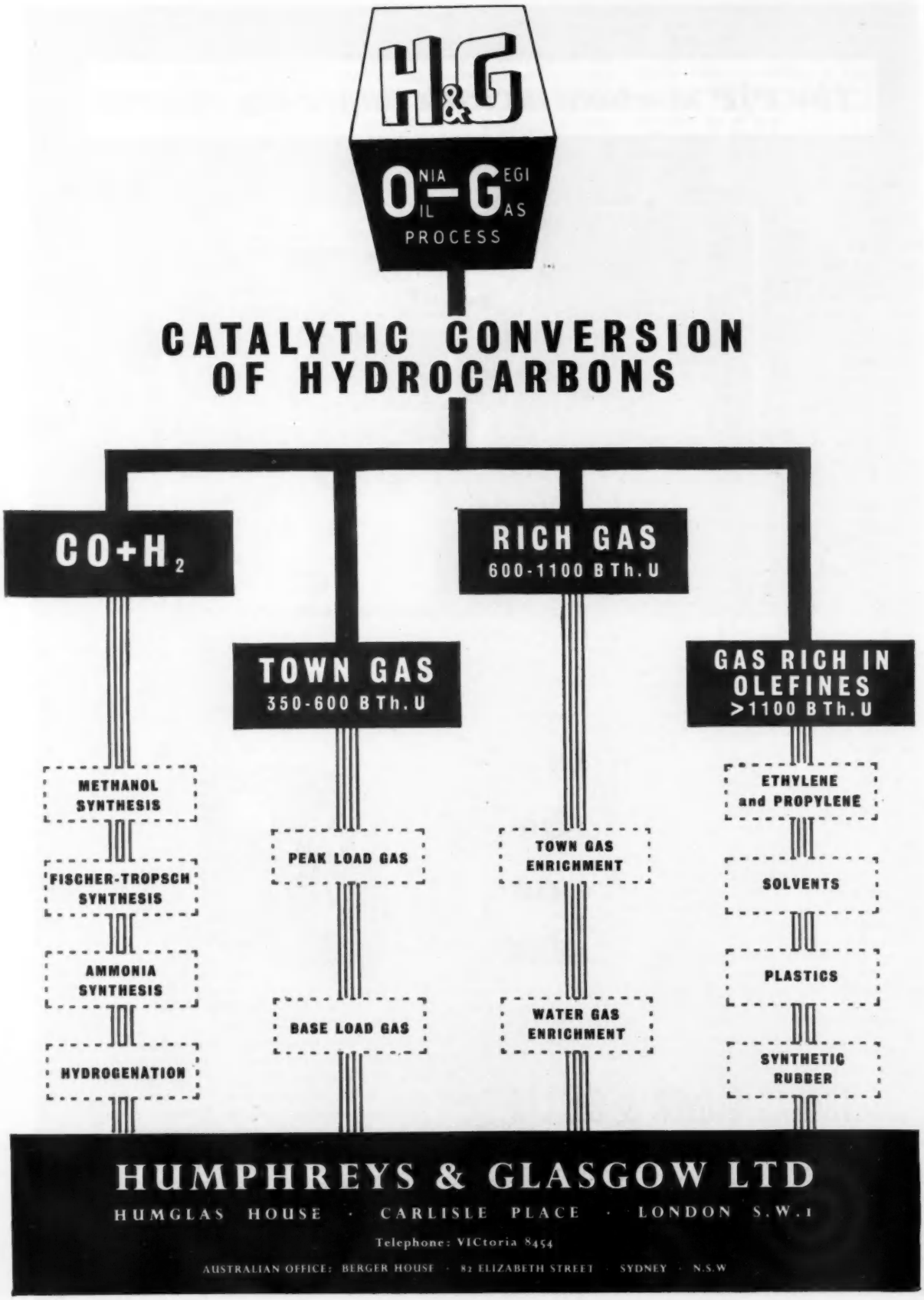
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bably introduced to the industry over 20 years ago. Is this satisfactory when one considers the opportunities which have existed, and still exist, for the sale of catering appliances in the last five years or more?

'Too often one comes across evidence of old gas appliances being replaced by, particularly at present, the forced draught type solid fuel cooker. Surely there is not one thing that this appliance can do any better than gas; but in the eyes of the owners or users it is something that is new in design, presumably economic in operation, and productive of satisfactory results.

'I am surprised, therefore, that the author makes no reference to this appliance in the section of the paper dealing with heat storage cookers, and I may say that in no case have I seen this particular solid fuel cooker installed specifically in kitchens where a 24-hour service was provided. On the contrary, it seems to be a choice in various types of catering establishments, and I can instance cases in a well-known group of hotels, in school meals kitchens and in large works canteens.

'In the school meals organisation alone the total sales of gas appliances must run into hundreds of thousands of pounds.

'Yet in general the gas industry takes little or no part in these transactions. Those who are responsible for the purchase of these appliances can have but little knowledge or experience of what can be regarded as good practice in such matters. If an appliance reasonably resembles its name, the education committees, by virtue of the ever-present need for economy, are more inclined to purchase obviously in the cheapest market—and unfortunately at prices equal to the same manufacturer's net terms to the gas industry, in our opinion a very unfair condition.

'In the South Western area some progress has been made in the direction of interesting education departments in allowing the Board to handle such enquiries, even on a cost plus margin, and in this connection the interest and the value of the Watson House Centre has had its effect.

'Two conditions have brought this about. One is the realisation by the Board, consequent upon a special investigation, that complaints arising from so-called ineffective service were, in fact, established as incidences of a complete lack of understanding by the school meals headquarters and operational staff of a simple "know-how" of selection, installation and usage of catering appliances.

'The second point is the existence of the Food Hygiene Regulations, 1955, of the Food and Drugs Act. While the author of the paper has referred quite briefly to these regulations, their influence and value in promoting sales is well worthy of further consideration.

'The author makes reference to the existence of a catering panel advisory to the Watson House Technical Committee. I am of the opinion that the standard of the brochures supplying technical information for owners or operators of catering establishments prepared by this panel could have been improved. One brochure entitled 'Gas and the School Meals Service' has been received with almost ridicule, in particular by competent school meals organisers, where reference is made to kitchen planning.'

Mr. Dunning, who then replied, said: 'First of all, with regard to the Ministry of Power standard, we in the Watson House Centre did make early representations to this Committee, and I think that the standard as now produced is quite satisfactory. It is in line with the British Standard in all respects. The fact that it asks in some respects for something higher than the British Standard is the prerogative of any buyer. If he is willing to ask and pay for a higher standard, he is entitled to have that higher standard. But the methods of applying the test and the standards required are still within the framework of the British Standard.

'With regard to explosions, I might mention that in the tests we carry out we blow up everything that comes to us. In that work we have had much valuable experience and we are able to show manufacturers how to design the equipment so that it cannot blow up. We quite realise that we are dealing with untrained staff, but a lot can be done in the design, as one manufacturer knows very well of one of the pieces of equipment we did blow up.

'There is one point people have mentioned on the Hypact burner: We have attempted to give higher speeds and higher temperatures—what the caterer has asked for. If he can do with lower temperatures he has only to turn it down. Once you have the higher temperatures, it is quite easy to have a lower temperature. And, of course, if it is not necessary you can arrange for it to be designed for a lower temperature and not leave it to the cook. I quite agree that you can easily waste gas.

'I am very interested in Mr. Klue's remarks with regard to automatic ignition. There is no doubt that big improvements will take place here. As with domestic appliances our aim is that when you turn on any tap it lights and then all questions of explosions and so on disappear.

'With regard to Mr. Benham's points, we are very interested in what he has to say. We are always torn between helping the manufacturer to the extent of designing his equipment for him and leaving it all to the manufacturer. Obviously the manufacturer who maintains expensive laboratories wants to feel he is getting some cash value out of them. I can assure you that he does, because the amount of technical help we are able to give is limited, and Mr. Benham will, I think, agree that the technical man can appreciate the help that we give and go away and use it to very much better effect than everyone else.

'I agree with Mr. Minchin that fundamental research is required, and more of it.'

Between sessions: A group of W. C. Holmes & Co., Ltd., men compare impressions.

Left to right: E. L. Eggins, Station Engineer, Cheltenham, O. H. W. Boonham, Divisional Production Engineer, Cheltenham, P. J. Purnell, Station Engineer, Gloucester.

Abstract of I.G.E. Communication 504

Coal Supplies for the Gas Industry

By CHARLES JOHNSON, M.I.Mech.E., M.Inst.Gas E., A.M.I.C.E.,
COAL OFFICER, GAS COUNCIL.

THERE has been a marked quickening of demand for power and energy throughout the world in recent years, and growing importance has needed to be attached to sources of primary fuels, principally as coal, oil, and natural gas, and more recently to the supply of nuclear power.

In recent years, the oil industry has greatly increased its refinery capacity in Great Britain and has made more readily available a wide range of products, which has encouraged a number of fuel users to change from coal to oil on account of the greater convenience of supply and use.

Whenever there is a shortage of fuel, or the supply of fuels gets out of balance, it is not unusual to ascribe the cause to lack of national policy, despite the difficulty of defining such a policy, still more of adhering to it when disruptive causes lie outside this country. It would be more rational to examine the nature of our fuel supply, of which coal is the major constituent.

In 1955 nearly half the total usage of fuel in Britain occurred as coal burned in the raw state, with the unavoidable accompaniment of ash, smoke, and general waste. Gas and coke were equivalent to only half as much coal as was burned in the raw state. The scope for economy in the use of coal, which one day may be forced upon the nation, is obvious and abundant. The gas industry must endeavour to avoid supplies of gas and coke being jeopardised over any period for which a shortage of fuel has been authoritatively forecast. It must also endeavour to ensure the greatest possible degree of market stability of gas and coke, particularly when smokeless zones are being created by local authorities in accordance with the Clean Air Act. Presumably, the gas industry will elect to participate fully in both markets rather than to limit its production of coke and consequently abandon part of its vested interest in that market.

It is imperative that the supply of indigenous coal be used most economically and that dependence upon imported fuels be reduced to a minimum. The essential import over the next 10 or 20 years could be so costly as to offset a disproportionate effort by other sections of industry, and this would suggest that a more rational and co-ordinated approach to the best method of using the nation's coal can no longer be delayed. Primarily, the responsibility for ensuring a rational disposal of coal according to consumers' requirements rests with the Ministry of Power, but in effect the implementation of any system of disposal rests with the National Coal Board. Understandably, legislation that might have for its purpose restriction of choice of coal would be introduced with reluctance; consequently, the preferred instrument has been price, which the National Coal Board has employed in a tentative way over the past few years. Seemingly, it has been its aim to safeguard supplies of coal with special properties by encouraging those consumers who did not need to use such coal to confine their demands to general-purpose coal, which was sold at a lower price. To achieve this, the price of carbonisation coal has been substantially increased, with the unfortunate result that prices for gas and coke have needed to be increased accordingly.

Consumption Not Influenced by Price

An even more unfortunate result, or lack of result, is that this price policy has not influenced the general body of consumers away from the use of carbonisation coal. Clearly, as a deterrent against its improper use, the ceiling price of carbonisation coal has not yet been reached and, as affecting the carbonisation industry, the desired end is not being achieved by the best means. It would appear more equitable to supply the requirements of different categories of coal consumers according to their needs and at prices consistent with the nature of the coal. The likelihood of bituminous coal remaining a permissible domestic fuel, at least in air-polluted areas, will diminish, and ample inducement should be provided to persuade industrial users of coal to modernise their power plants so that general-purpose coal can be burned more efficiently and more economically than the carbonisation coal that many of them are now burning. A more positive deployment of specific coals into specific markets, aided by a price structure more directly related to quality, would encourage the gas industry to review its sources of manufactured gas, safe in the assurance that there would be an adequate supply of suitable coal and that gas and coke could be manufactured at a cost that would stimulate their widespread use in preference to raw fuel.

Pattern of Traditional Supplies

By the time of the outbreak of the second world war a pattern of traditional supplies of coal to the gas industry had become established in a period of relative stability as affecting both the methods and the economics of gas manufacture. It was possible to predict within narrow limits the quality of the coal to be received and the results to be obtained when it was carbonised under normal conditions. The gas industry mostly used high-quality coal, much of it graded, preferably not exceeding 6% of ash or 2% of sulphur, capable of giving a good thermal yield of gas and a good proportion of robust coke when carbonised at a high temperature. Exceptionally, coal of less suitable quality was used as a matter of local economy where savings in price and cost of transport could be effected.

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Mr. Charles Johnson

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In Scotland, where weakly caking and non-caking coal preponderated, the general trend was towards the carbonisation of graded coal in vertical retorts. In the North of England, Northumberland graded coal and Durham mixtures (miscalled 'unscreened') were used. In the Midlands generally, Yorkshire coal was preferred, but substantial quantities of Lancashire, North Staffordshire, Nottinghamshire and Derbyshire coal were also used, most often locally, with a marked preference for graded sizes. In the London area and along the South Coast, Durham mixtures were almost invariably used because of the low cost of coastwise transport from the coalfield, despite the strongly caking nature of much of the coal. Away from coastal areas, in the South, much Yorkshire coal was used, and there was no alternative to the high cost of its transport by rail. In the South West, considerable use was made of the coalfields of South Wales, Bristol and Somerset, and Forest of Dean, although much of the coal was difficult to carbonise and contained a high proportion of ash. Similarly, but of less significance, some strongly caking coal from the Kent coalfield was used locally.

Although since 1938 the annual quantity of coal supplied has increased by 8 mill. tons, or nearly 40%, the proportions from the major coalfields have been fairly well maintained, if due allowance be made for the changed conditions within the coal industry as a whole. The overall shortage of carbonisation coal in Scotland cannot be remedied, and substantial quantities of coal have needed to be supplied from Northumberland and Durham to meet the requirements of the Scottish gas and coking industries. The total import of coal amounted to 11¼ mill. tons in 1955, and to 5 mill. tons in 1956, but, unfortunately, the facilities at British ports designed for the export of coal were not equally well suited to its import. Supplies of home-produced coal may be inadequate in future years, and some gas boards may have to unload and use imported coal. In those circumstances, they should be permitted to voice an opinion about the type of imported coal that they could best use.

The proportion of coal from the North Eastern Division has been maintained, although to do so has involved an increased annual supply of 2½ mill. tons. Yorkshire coal has a deservedly high reputation, but the expected supplies have not materialised and requirements have been met by a degree of substitution of inferior coal. This coalfield is preponderatingly the mainstay of the gas industry and apparently will remain as such so long as the best all-round economy for the majority of gasworks depends upon high-duty carbonisation in continuous vertical retorts to give the maximum production of gas at approximately declared calorific value and of clean free-burning coke.

Importance of East Midlands

The East Midlands Division generally stands in support of the Yorkshire coalfield; its gas coal comes principally from Nottinghamshire and Derbyshire and is not of as good quality at Yorkshire coal. The East Midlands will ultimately assume a position of major importance to the nation, and perhaps to the gas industry; particularly if the production of special coke were to become substantial. In the period under review, supplies from the East Midlands coalfield to the gas industry have increased by 2 mill. tons a year.

In 1955, the supply of coal consisted of 73% as graded coal normally of ¼ in. by 2 in. size or bigger, 24% as a mixture of sizes (usually designated as 'unscreened,' 'reconstituted' or 'thro' and thro'' and meaning a mixture of all except the larger sizes), and 3% as smalls. Included with the graded coal was approximately 1 mill. tons of large coal such as the gas industry would not normally require. The extent to which large coal augmented the supply of gas coal was an indication of the strained resources of graded sizes. The inclusion on occasion of other coal of less suitable type was a similar indication.

The gas industry has a limited interest in the very strongly coking coal of Durham and South Wales and the very strongly caking coal of Kent, Bristol, and Somerset. Adequate quantities of coal of these types were available and were supplied to the appropriate extent of 6½% of the total. The main and essential supply for the great part of the industry is the high-volatile caking coal of ranks 500 and 600, and to a lesser extent of rank 700, which gives a high yield of gas and a robust coke. The proportion of coal of ranks 500 and 600 increased from 64% in 1948 to 77% in 1955 and the proportion of rank 700 decreased from 19% to 10%. Much coal of rank 700 was fully acceptable as a local supply, particularly in Scotland and Lancashire where there were deficiencies of the more desirable types of coal. The proportion of weakly caking and non-caking Scottish coal, of ranks 800 and 900, used for gas making has nearly doubled since 1948 at the expense of rank 700, but with a slight compensatory lift in rank 600. Respecting other coalfields and after taking into account coal required for total-gasification plants, the small remaining proportion of coal of rank 800 probably reflected the extent to which unsuitable coal, as exemplified by rank, was accepted in substitution for more desirable types.

The total moisture in the coal received was 5%, about half of which was adventitious and reflected the growing extent to which washing has become an integral part of coal preparation. The average ash content was 6.3%, dry basis. The figure for the Scottish coalfield was nearly 8% and reflected the faulted and difficult nature of many of the higher-rank seams. It might have been expected that where there had to be recourse to the more abundant low-rank coal the supply would have been of lower ash content. The average ash in the coal supplied from the Northern and Durham coalfields was 7.8% and 7.5%. dry basis, respectively, which was substantially higher than for supplies before the second world war. Cumberland coal is mostly high in ash and not easily cleaned, Northumberland coal is variable and Durham coal is mostly low in inherent ash. Coal preparation over much of this area is in course of transition from dry cleaning to washing. Eventually, clean coal should again become available although it is likely to be accompanied by much water, which will be regretted as Durham coal is naturally low in inherent moisture. Over the main Midland coalfields, the average ash content was 5.3%, dry basis, and for the best coal was lower and probably approaching the economic limit. In Lancashire, natural difficulties have now imposed a limit on the availability of clean high-rank coal owing to the age of the coalfield and the faulted pattern of many of the seams. Somewhat similar circumstances prevailed in the North Staffordshire coalfield, but there will continue to be a valuable supply of gas coal from this area. In the South Western Division, coal from the South Wales coalfield is of higher than average ash content; from the Bristol and Somerset coalfield exceptionally so and to the extent that coke of satisfactory quality cannot be produced from it. It was largely on this account that the average ash in coal received from the South Western coalfield as a whole amounted to 8.1% dry basis.

The availability of town gas has increased from about 260,000 mill. cu.ft. in 1921 to 603,000 mill. cu.ft. (2,900 mill. therms) in 1955, and with minor exceptions the availability has increased each year. The annual rate of increase between 1921 and 1939 was 1.7% compound, between 1939 and 1955 it was 3.4%, and over the whole period 1921 to 1955 it was 2.5%. Gas boards have estimated a total availability of 3,090 mill. therms of gas by 1960, which implies an annual rate of increase of 1.6% compound.

The increase in gas available by 1959-60 will be 188 mill. therms, of which 161 mill. therms will be purchased and 27 mill, therms will be made at works. This indicates that increased purchases of gas will nearly suffice to meet the expanded requirement by 1960. The principal increase will be as coke oven gas, but a notable new source will be gas made from oil products adjacent to a refinery. The quantities of coal carbonised and of coal gas made will be virtually unchanged, water gas will be reduced by over 95 mill. therms, and oil gas will be increased by more than that amount.

Coking Industry Gas Purchased

The major source of purchased gas will be the coking industry. At present slightly more than half of the total gas made at coke ovens is used by the gas industry and the iron and steel industry, in about equal proportions. The gas industry might, therefore, be able to purchase coke oven gas up to a rate of 550 mill. therms a year, or more according to the fuel policy of the industries concerned.

Oil refinery gas as a source of town supply is planned to increase to 49 mill. therms by 1960; over British oil refineries as a whole there would seem to be capacity to increase this quantity substantially. There is no indication of any significant change in the small quantity of liquefied hydrocarbon gas purchased from oil refineries for use as a source of town gas.

The quantity of methane from coal mines, supplied to the gas industry in 1955, was 300,000 therms. It is unlikely that recovered mine gas in relatively pure form will become substantial in the foreseeable future, although where it occurs mine gas may have local significance, particularly in North and South Wales.

Small supplies of natural gas have been located in Great Britain, and a limited commercial exploitation is due to start very soon.

Given reasonable participation in world trade, it might be justifiable to assume that the demand for town gas in Great Britain will continue to grow and that the price of gas relative to other principal fuels will not change adversely. Implementation of the Clean Air Act, 1956, should have the effect of increasing the demand for gas and coke, with the probable result that greater use will need to be made of coal carbonising plant and less use of gasification plant, particularly of plant for the manufacture of water gas and of producer gas as a diluent.

There is no firm estimate available of the total requirement of gas by 1965, but, as mentioned previously, an annual progression of 1.6% indicates a figure of 3,345 mill. therms. Purchased gas, including gas purchased from or made at oil refineries, may be of the order of 695 mill. therms and so there would need to be made at works 2,650 mill therms. Under operating conditions such as area gas boards have assumed would prevail in the year 1959-60, the quantity of coal to be carbonised in the year 1965 would be 30 mill. tons and the quantity of coke available for sale would be 12½ mill. tons. If it were designed to sell as much coke as possible and the same proportion of assumed base-load gas made in water gas plants were transferred to coal gas plants as, by way of illustration, was shown for the year 1959-60, the quantity of coal to be carbonised would be increased from 30 to 31½ mill. tons and the quantity of coke available for sale would be increased from 12½ to 13½ mill. tons.

Underground Storage

The underground storage of gas in gas-tight geological structures of anticlinal form has become an established feature of the transportation and storage of natural gas in America. Similar practice is now being adopted on the Continent, where three storage systems have recently been constructed with working capacities ranging nominally from 4,000 to 11,000 mill. cu.ft. of gas. Underground anticlinal structures exist in Great Britain: some are known to be faulted and fractured, some are known to contain natural gas, and for some others it would need to be proved whether they were capable of retaining gas.

The purpose of mentioning the subject here is that underground gas storage might ultimately be the means of providing the most economical system of supply. Gas-manufacturing plant could be centralised at strategic points and the majority of gas-consuming areas could be supplied by an integrated gas distribution system embracing main sources of gas and bulk storages. Peak-load and seasonal-load production might eventually be eliminated and, if so desired, the whole of the production could be confined to coal carbonising plant, thereby ensuring maximum availability of coke.

It would be reasonable to expect an improved gas yield as a result of increased base-load working of carbonising plant, and the present yield of 75.2 therms per ton of coal carbonised might increase to 77 therms. In such case, the annual quantity of coal carbonised by 1965 would be 34½ mill. tons and the quantity of coke available for sale would be 16 mill. tons.

With a high degree of integrated supply, a plant load factor of 90% should be attainable, thereby requiring a total installed capacity of 8.1 mill. therms a day, all of which could be carbonising plant. The total installed capacity of all gas-making plant in April, 1956, was 11.8 mill. therms a day, of which 7.6 mill. therms was carbonising plant. Gas boards have estimated that the installed capacity of all gas-making plant by April, 1959, will have been increased to 12.34 mill. therms, but carbonising plant will have been reduced to 7.34 mill. therms. The load factor on all plant will then be 56%, and on carbonising plant will be 78%. The achieve a possible requirement of installed capacity in 1965 of 8.1 mill. therms of gas made a day, consistent with a load factor of 90%, the annual rate at which new plant will need to be provided will be no greater between 1960 and 1965 than the rate at which area gas boards have estimated to install new plant up to 1960.

The National Coal Board has estimated that the annual availability of carbonisation coal will increase from 87.5 mill. tons in 1955 to 98.5 mill. tons in 1965, but there is no information to indicate what will be the contributon from each coalfield. Not all carbonisation coal is sufficiently low in ash and sulphur to be suitable for use by the gas and coking industries and it is usually desirable to limit the sulphur in coal used for the production of metallurgical coke to 1½%, and in coal for gas making to a figure of fairly similar order. According to Ellis, 97 mill. tons of carbonisation coal were available in 1952, but only 61 mill. tons were of a quality suitable for use by the carbonisation industry.

Consistent with published information, an estimate has been made of the quantity of carbonisation coal that will be of a quality suitable for use by the gas and coking industries in 1965. As a criterion of suitable quality, there has been discarded half the coal available from seams containing between 1.6% and 2.0% of sulphur, and all the coal containing more than 2.0% of sulphur, also half the coal from seams containing between 8% and 12% of ash, and all the coal of more than 12% of ash. If the estimate of the National Coal Board is fulfilled, namely that 98 mill. tons of carbonisation coal will be produced in 1965, then it is estimated that within the above-mentioned limits of sulphur and ash not less than 62 mill. tons will be of a quality suitable for carbonisation, and about 36 mill. tons will not.

In 1956, the gas industry carbonised 28 mill. tons of coal, and the coking industry, 29 mill. tons, making 57 mill. tons in all. and of this amount about 50 mill. tons was carbonisation coal within ranks 301/600. It has been estimated that under certain circumstances, perhaps remote in its case, the gas industry might carbonise 34 mill. tons in the year 1965, and the coking industry, 40 mill. tons, making a possible total requirement of 74 mill. tons. Not all this quantity needs to be carbonisation coal, as by 1965 a higher proportion of low-rank coal will be used than at present for blending. Some coal of higher ash or sulphur content than was deemed suitable by the quality discard method will continue to be used locally, and some coal of rank 700 will be used. Within an estimated total annual requirement of 74 mill. tons, the requirement of carbonisation coal of suitable quality will probably be of the order of 60 mill. tons and will not, therefore, exceed the estimated availability of suitable carbonisation coal.

The size of the available coal is of considerable importance to the gas industry because of the economical working of graded coal in continuous vertical retorts: at the present time, 73% of the total supply is graded. The coking industry requires all small coal, and it is of little consequence what sizes are delivered, because supplies are crushed to ¼ in. or less according to the degree of blending practised. It is fortunate for the gas industry that there is an abundant supply of small carbonisation coal available for the coking industry, and that the complementary nature of the requirements of these two industries permits of the whole production of suitable coal being acceptable to them.

Dependence on Imported Fuels

The steady rise in industrial activity and social standards in Great Britain has resulted in a substantially increased consumption of fuel so that the total requirement has now outstripped available supplies from home sources and has created an undesirable dependence on imported fuels. Regardless of whether coal production can be restored to its old order, the national economy will be best served by endeavouring to use coal with the highest practicable degree of efficiency. It has been authoritatively estimated that many millions of tons of coal could be saved annually by the use of modern equipment and more amenable fuels. Unfortunately, consumers have the impression that coal is still the cheapest fuel, and so there can be little hope of voluntary change unless supplies of coal are made more difficult to obtain and more expensive to buy in those markets that it is desired to discourage. At the same time, the carbonisation industry needs the opportunity to be able to sell gas and coke into those markets at such prices as will induce consumers to make the required change without apparent persuasion. Such a policy appears to be the reverse of what has applied over recent years, during which time the price of carbonisation coal has been progressively increased but without achieving the desired effect of discouraging consumers from burning carbonisation coal in the raw state. It may well be the case that national economy in the use of coal, and the hope of any substantial reduction in atmospheric pollution, depend for their success on a much more sensitive system of coal prices than has hitherto existed.

It is hardly to be doubted that, for as far into the future as needs to be seen, the gas industry will welcome an opportunity to substitute smokeless fuels for high-rank coal as fast as this is progressively withdrawn from the market. With certain significant exceptions, carbonisation coal is being restored to an acceptable standard of quality, and there is evidence that supplies for the future can be satisfactorily maintained. The limit of the nation's mounting fuel requirement is not yet predictable, but the physical limit of its coal production cannot now be expected to rise accordingly. Never before has the need been greater than at present to safeguard our indigenous primary fuel resources.

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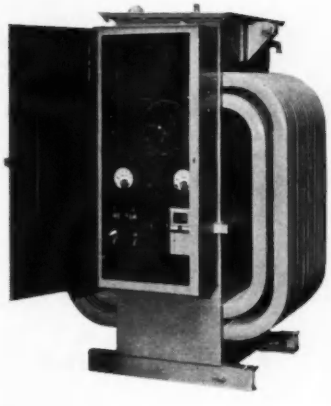

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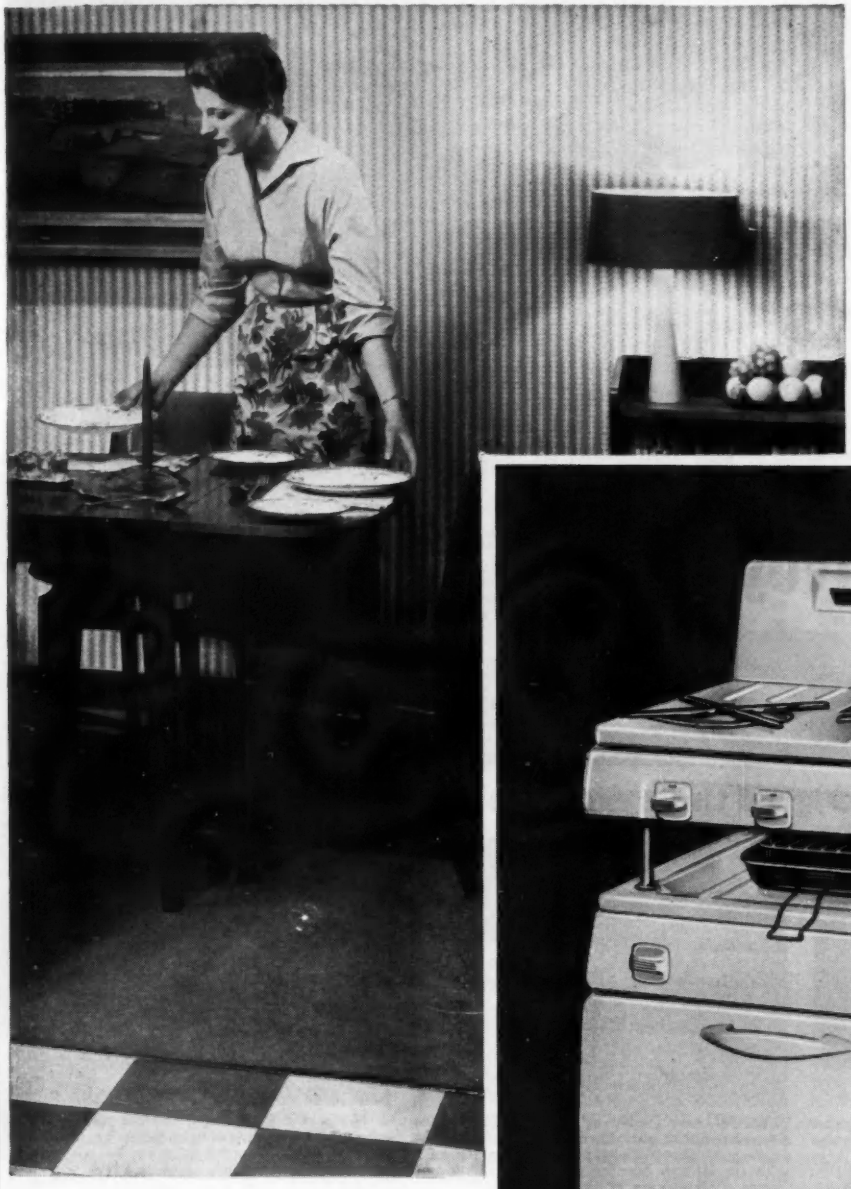

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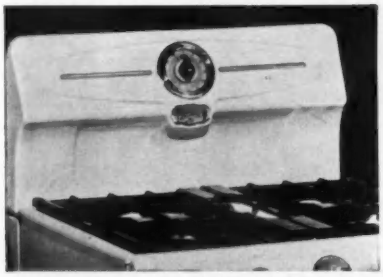
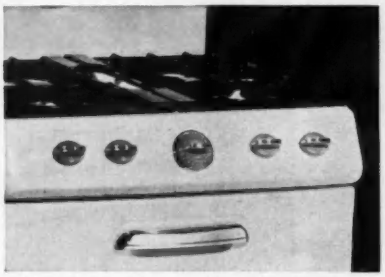
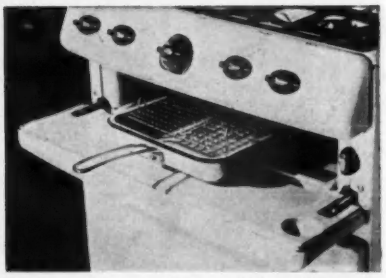


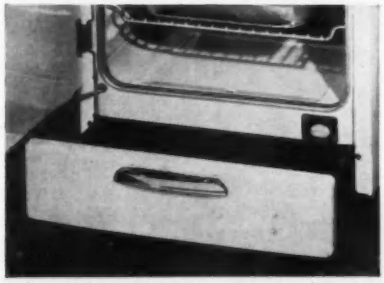
1. Ultra-modern short splashback is fitted with a built-in long-period timer. We haven't forgotten a place for the plates though—there is a large storage drawer under the oven, doubly useful for warming the plates gently while the oven is on.



2. Entirely new 'glide-over' hot-plate design gives safe, non-spill support for even the smallest milk saucepans. Streamlined press-turn safety taps, with special LOW burning position, available in a choice of six colours, at no extra cost.



3. The grill is extra-large, and the grilling compartment has the new light-reflecting 'Ice-Blue' interior finish. The fall-door has been specially styled to give a smooth, absolutely level working surface when in the 'down' position.



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DISCUSSION

Dr. A. C. Monkhouse (Acting Director, D.S.I.R., Fuel Research Station), said that in reading the introduction to the paper, Mr. Johnson appeared to be rather optimistic on the question of supplies to the gas industry of coals of the desired type. 'He indicates that more carbonisation coal will be available in total than the gas and coking industries are likely to require; while Mr. Ingram in his paper "An Approach to the Use of Oil Gas in an Integrated System" states in his introduction that the overall shortage of good quality carbonisation coals appears to be a permanent factor in the gas industry. Perhaps this is merely a question of the definition of terms.

'The Air Pollution report envisaged the replacement of 19 mill. tons of coal burnt in the black areas by fuel burnt smokelessly. It had always been hoped that the more efficient type of coke-burning appliance would be installed; but it may only be possible to install a simple coke-burning appliance. If more reactive coke is therefore required than the average gasworks coke, then there is no doubt that the gas industry could with advantage use more low rank coal by carbonising blends of low rank coal with strongly caking coals in the static type of plant, which carbonises about 45% of the total coal. This policy is more applicable in areas where the different types of coal both occur, or where they can be blended without undue high transport cost.

'Coke produced from these blends can be of adequate strength and more free burning than typical gas cokes. The thermal yield of gas and coke per ton would be lower, but as has been shown in some earlier papers to the Institution of Gas Engineers, the process can be operated successfully, both technically and—it appears—financially.

No Marked Expansion

'Mr. Johnson does not envisage a marked expansion in carbonising plant and has considered means within the existing framework of increasing coke production for the domestic market. By increasing the proportion of carbonising plant on base load and by taking into account purchased gas or gas from oil refineries, the coal carbonised could increase by 1956 to 31½ mill. tons, and the quantity of coke available for sale to 13½ mill. tons as against 11 mill. tons in 1955/56. If surplus gas could be stored, then the quantity for sale rises in 1965 to 16 mill. tons. This is a very interesting analysis of the possibilities.

'If we look, however, at the coke produced by the gas industry in 1955/56, we see it would be about 70% of the coal carbonised, but the coke available for sale is only about 40%, or including the coke used for the manufacture of water gas about 45%. If the breeze content of the coke is taken as 15% of the total coke, the large coke used for heating the settings is about 14% of the coal carbonised, or about 4 mill. tons per annum. So it does seem that if small low grade coal could be used for the production of low grade heating gas—and there are possibilities there—there would be made available more large coke for domestic purposes. This may not be practicable in all cases, but it does present certain possibilities. Another source is the lump coke used in water gas manufacture. This might in future processes be replaced by small coke.'

Mr. H. R. Hodgson (National Coal Board): 'Mr. Johnson has given an indication of probable coal requirements for the gas industry over the years ahead to 1965, ranging from 30 to 31 mill. tons or 31 to 31.5 mill. tons, or in certain conditions to 34½ mill. tons. The range of possibilities, therefore, is quite considerable.

'At the same time, using the information which has been provided in one way or another, he has assessed the availability of coal in the carbonisation ranks and in rank 700, and has drawn the inference that there would probably be more than sufficient coal available to meet the total requirements of the gas and coking industries on the assumption that the requirements of the latter, the coking industry, would expand to about 40 mill. tons by 1965.

Sulphur Problem

'Without, if I may say this, committing my employers by a very specific statement, I should say that the estimates of availability are within the reasonable probabilities, but I think it would be right too to say that nature has presented the Coal Board and, if you like, the carbonisation industries with a problem—that of the tendency for the sulphur content of these coals to rise.'

Mr. Hodgson went on: 'From the Board's point of view, it would help to solve part of the problem if so soon as is reasonable we could have from the gas industry more detailed estimates of their future requirements as between the several area gas boards, so that these requirements can be matched with the availabilities of gas coals in the Board's several Divisions and the Board's plans laid and adjusted to meet them as may be appropriate. I think it is a fair statement to say that theoretical possibilities and difficulties quite often give way to practical solutions, and a good deal has been learnt in the past about the acceptability of particular coals at individual plants.

'In connection with these forward estimates to which Mr. Johnson has directed his attention, I should like to express a personal opinion that the forward requirement of about 40 mill. tons of coal for the coking industry by round about 1965—I emphasise that this is a personal opinion—is probably an under-estimate, having regard to the requirements of the iron and steel industry for the manufacture of metallurgical coal. I think it is a fair assumption that for some time the blast furnaces will be the primary tool of the iron and steel industry.'

Mr. George E. Currier, O.B.E. (Deputy Chairman, North Eastern Gas Board): 'Since the end of the war there have been numerous attempts to forecast the long-term demand for and supply of fuel. The various estimates which have been published are unanimous in one respect. They all foreshadow a shortage of coal. They differ only as to the extent of the deficit. All are supported by a wealth of statistics, and Mr. Johnson has had an unenviable task in analysing these figures and preparing from them his own contribution to the prophecies.

Coal Not Ousted

'Though there are many interesting gasmaking processes under trial at present, all of which aim at producing a cheaper therm, none of them has yet proved so successful, technically and commercially, as to oust coal from its position as the main source of gas in this country. The future of our industry is, therefore, vitally affected by the quantity, quality and cost of the coal available to it, and we welcome Mr. Johnson's review of present and future supplies.

'The author's references to extended grid supply systems, based on underground storage of gas, are full of interest, particularly to those who have seen similar schemes in operation in the United States of America. Unfortunately, the expert evidence available indicates that there is only a remote possibility of finding suitable storage for substantial quantities of gas in this country.

'With so many new processes for the production and supply of gas still in the experimental stage, it is difficult to forecast the future requirements of raw materials, but it is apparent that our needs are going to be affected more by the current trend in gas sales than by the Coal Board's development schemes.

'The situation as we meet today might suggest that the difference between an abundance and a shortage of coal is marginal rather than substantial. The coincidence of a mild winter with a slight increase in output leaves the country with a surplus of approximately 4 mill. tons of coal compared with 1956, and the National Coal Board embarrassed by the problem of how to sell coal.

'We must be grateful to the Coal Board for their successful efforts to maintain deliveries to the gas industry in the post-war years. Even in the worst winter supplies never failed, though we have at times been obliged to accept inferior grades, to pay for unusually long hauls, and to bear the cost of transferring coal from one manufacturing station to another.

'We understand and appreciate the many problems which the Coal Board has to solve if all their customers are to receive fair treatment in the matter of supplies. They, too, should understand that the carbonisation process, as prac-

tised in the gas industry, is largely selective as to the size and types of coal which must be used. Mr. Johnson assures us that the coal now being supplied to the gas industry is mainly satisfactory, a high proportion being of these desired types and sizes. I am sure that this pleasing report will not lead to complacency—the use of average figures of coal quality can hide the fact that a number of gasworks are still called upon to carbonise coals containing 10% to 20% of ash. Continuous pressure on the Coal Board has resulted in considerable improvements in coal quality, but there is room for further progress.

'This progress must involve the erection of more washeries and the consequent danger, mentioned by Mr. Johnson, of substituting water for ash. We dislike buying water at the price of coal, but it is probably less of a nuisance than ash and we must bear in mind that the satisfactory supply of reasonable quality coals is largely due to the installation of washeries which are converting to gas-making standard coals which were previously too dirty to be used for this purpose. There have been cases, particularly with washed mixtures, where the inert content after washing has been as high as that of the uncleaned grades prior to washing. On the other hand, a typical case can be quoted where the ash and moisture in a dry coal ranged up to 28%, whereas in the grades now produced by washing this coal, the ash and moisture rarely exceeds 9%.

Formula for Assessment

'The Coal Board have adopted a formula for the assessment of gas coal prices, and though the gas industry has not accepted the formula, it is in operation and we have to take note of the effects. The Coal Board may, to some extent, have defeated the purpose of their formula by applying commercial adjustments to the calculated prices, but there is some doubt as to whether this has been done in order to influence consumers to restrict their use of carbonising coals. Other coal users demand these special grades of coal for their particular manufacturing processes, and it should be remembered that in industry generally coal represents only 3% of manufacturing costs whereas, in our industry, it accounts for more than 60%. Programming of supplies to all industries and the regulation of deliveries within the programme, rather than pricing policy, appears to have been the Board's means of ensuring that all consumers received a fair share of the available coal. There have often been occasions when we have disagreed with their interpretation of "fair shares." That this should be so is largely due to the absence of any kind of national fuel policy.

'Some of us were asking for a defined policy at least 20 years ago, long before there was a Ministry of Fuel and Power, when the gas industry was within the orbit of the Board of Trade. Although the Ministry of Fuel and Power was established in 1942, there is still no national fuel policy except to the extent that many gas and electric appliances are saddled with purchase tax, though oil and solid fuel equipment which provides the same heat services are free of purchase tax.

'This policy, together with those of the Coal Board with regard to both the control of supplies and the coal price structure, has been approved from time to time by successive Ministers of Fuel and Power and the Governments they have represented, irrespective of their political colour.

'Nevertheless, we in the gas industry must continue to urge upon the State's policy-makers the great importance of coal as our principal national asset, and the need to encourage those industries which make the most efficient use of coal.'

Clean Coal Never Available

Dr. R. Lessing, pointing out that Mr. Johnson had said that clean coal should *again* become available for the gas industry, stated: 'Well, I say it never was.

'Coal to be the ideal, and the practical ideal, for carbonising both in regard to volatile products, gas and tar and ammonia, and in particular coke, must have a very much lower ash content than it ever has had and than it has to-day in order to supply the needs for solid fuel which are now envisaged and demanded in the implementation of the Clean Air Act.

'The average of ash shown in the table as taken over all divisions is 6.5%. Mr. Currier has just pointed out that averages do not always reflect reality and that we also have to deal with the maximum coal ash content of 10 to 20%. But even taking that average as the present standard, if we may call it a standard, we should have to reckon with an ash content in the coke to be used for domestic purposes of 10% at the very lowest.

'If we really want to get on with the clean air policy, we cannot afford to force on the housewife the task of dealing with 10% of ash in the fuel used in the grate or other appliances, because it will always be considered that the crux of the problem will lie rather in what happens within the house than in what goes out of the chimney. This high ash content in many cases will militate against the use of coke, which is wanted.

'Moreover, a low ash content of the order of 3%, which has been proved to be possible (granted not in all cases), would also have much greater advantage in reactivity, quite apart from the easier working and the greater utilisation of the carbonising capacity in the gasworks. It is therefore the duty of the gas industry, in my opinion, to press for very much better coal cleaning.

'We must not think that in reducing the ash to the extent I have mentioned the coal producer, the National Coal Board, would economically lose, because for this purpose and for general purposes the ordinary removal of ash-bearing minerals will not be sufficient. Coal preparation must be done by multi-product working. We shall have to have at least a three-product washer. One product would be the very low ash content coal for carbonisation. The second would be the medium ash content coal from, say, about 7 to 15% or even higher. And it is the pride of combustion engineers that they are able to use coal of any ash content, however high. That would be diverted into the boiler-working industries particularly the electric generating industry and other industries and could be used there. It would have a low caking power and be more amenable to general working.

'The third product would be the high ash refuse, as it has been called hitherto, which still contains something of the order of 20% of carbonaceous matter and which, with the modern processes we discussed this morning in connection with gasification, could be used and, indeed, in a small measure was used 30 years ago.

'If this is done, another advantage will be obtained in relation to the availability of gasmaking coals.

'Mr. Johnson mentioned in his paper that there will be plenty of coal available for carbonisation but it will not be of the same quality in respect of inherent ash and sulphur content. If three-product washery work is adopted, we shall find that the lightest brightest coal of low specific gravity will also be the lowest in ash content, for it is in the nature of the coal formation of this particular component that its ash is low, hardly ever exceeding a true 2%. I think the sulphur is equally low. There are many coals which we call to-day non-carbonising coals with layers of this kind of bright material. It will make good coke and incidentally will not be highly swelling. In the washery principle which I advocate, they could be easily separated without extra cost, simply by having another spout, so to speak, on the washer and the necessary collecting arrangement.

'There ought to be no fear, therefore, that we should not have enough carbonising coal for making coke as it is desired and as it will be desired for implementing the Clean Air Act, in the use of solid fuel.

Higher Moisture

'Mr. Johnson makes the point that the higher moisture indicates the need for more washing. Mr. Currier referred to a similar point in his remarks. That is again a question which can be overcome and for which methods have been proposed and worked. A serious reason for the higher moisture content of washed coal is that the coals are washed without previous removal of natural coal dust, a matter to which I have referred on many occasions. This holds back the moisture. They are washed in a slurry made by the washing water with this dust, and a certain amount will always adhere to the surfaces of the clean particles in the coal and will remain there and retard the draining possibilities of that coal. If, on the other hand, the dust is previously extracted in a very simple way by pneumatic means as has been done in pre-nationalised days in at least twenty-five plants in this country, mostly connected with coking plants, the coal will be all clean surface and will allow draining and the dust will not be there.

'We have really made no progress, as implied by the paper, in regard to this coal preparation problem.

'I had the privilege to place before the Royal Commission, the Samuel Commission, in 1925 my views on these points, and they were epitomised in the Cantor Lectures of the same year. I will read the concluding sentence. It bears on the point made by Mr. Johnson that one must not be prophetic in any of these statements.

Too Prophetic ?

'It says "Though it is never safe to prophesy, I make bold to suggest that within a very few years the carbonising industries which are mainly concerned with the efficient recovery of the intrinsic value of coal will feel constrained to insist for their raw material on coal containing only a fraction of the proportion of mineral matter which is customary today. I firmly believe that the provision of such a commodity will be technically possible and commercially profitable, and that it will be of economic advantage both to the supplier and the user."

'I venture to suggest that these words are as true today as ever they will be. Whether they are too prophetic even today after all these years I leave to the future to judge.'

Dr. J. Burns (North Thames Gas Board): 'The coal price structure, together with the selective additions which have been added to the price of coal for the last ten years, has been the biggest factor in the competitive position of the gas industry in relation to electricity, and it is greater than any other at the present time. If the price differential between the price for coal, electricity and gas was right in 1950 when the coal price structure was first instituted I do not think it is likely to be right now, when that differential has grown out of proportion to any increase in price since then.

'We are very interested to hear at all times anything about the quality of coal, and I was interested to hear Mr. Johnson's opinion that the quality of coal is in the main improving, let us say, for the gas industry. I am sorry to dispute that to some extent, for there is this point: That just the other day I happened to look at the average inert content of all coals supplied to my own Board over the last year, representing some 5 mill. tons of coal with approximately 70% coming from the north-east coast, Durham and Northumberland, and 25% from Yorkshire. The figures showed that there has been an increase each year since 1950 to the present time. There has been an increase from 11.5% last year to 11.9% this year, so the increased inert content is still going up.

'You may very well ask whether the inert content now constitutes moisture or air. I am sorry to have to say there has been an increase in both air and moisture, and the position is that although we are getting a larger proportion of coal washed that proportion gives a higher moisture content and the proportion which is unwashed has a higher than ever ash content which outweighs the disadvantages of washing. Indeed, the Coal Board have a very great problem before them on this question of the moisture content of coal. Or rather that problem is being clearly transferred to the gas industry because we get the wet coal. We have very considerable difficulty in handling that coal and the higher moisture content does constitute a very real problem.

'We in the gas industry have learnt to use practically any type of coal and we have learnt to use practically any grade of coal. But we have also learnt at the same time that some grades are better than others, and we have a preference for some grades. Especially in the matter of carbonisation of low rank coal, we should like to be able to select certain grades.

'I wonder whether it would be too much to ask if the Coal Board could take this into account in the various new methods of machine mining; whether they might have consideration to the fact that one of the biggest and most important customers, the gas industry generally, has a need for graded coal and might attempt to develop means which will provide a certain amount of that coal. I say straight away that we can use any type of coal, but we have a preference for graded coal for some specific purposes.

'There is always this difficult problem of prognosticating what we shall require in 1965 and so on. Really, we could give an answer in the gas industry of our requirements in 1965, but I think we could give a very much clearer answer if we knew from the Coal Board what the price of coal in relation to other raw materials is likely to be in 1965 and what their production programme is likely to be at that time.'

The President asked Mr. Johnson to reply in writing to the discussion.

INSTITUTION BENEVOLENT FUND

SIR HENRY JONES, Chairman, presided at a general meeting of the contributors to the Benevolent Fund of the Institution.

The Honorary Secretary, Mr. W. T. K. Braunholtz, O.B.E., read the notice convening the meeting, and the minutes of the general meeting held on May 30, 1956, were taken as read and confirmed.

The Chairman moved that the report of the Committee of Management of the Fund for the year 1956-57 and accounts for the year 1956 be taken as read and adopted.

Sir Henry asked all contributors to do what they could to persuade others to contribute and to bear in mind that the value of money in these days 'is unfortunately not constant. While they may have fixed what seems to them and to us a generous contribution only a few years ago, today each pound may only be worth 15s. or less. I would ask those who can to review their own contribution to see whether they cannot make some modest increase.'

Mr. R. L. Greaves seconded the resolution. The resolution was carried.

Mr. F. Wilson, proposing a vote of thanks (on behalf of contributors) to the Chairman, Committee of Management and Secretary of the Benevolent Fund, said the financial statement was a warm, human document. Relief had been given to colleagues who were in trouble and the Committee had looked into every case most sympathetically and kindly.

'To me it is disappointing to see that once again the subscriptions were not sufficient to meet the needs of the Fund,' Mr. Wilson added.

Mr. J. B. Taylor, seconding, advocated that the junior gas associations should take an increasingly responsible part in furthering the interests of the Fund. 'But first,' he said, 'each association should make its own donation although in this I know there are many difficulties. The membership of the district sections may be drawn from several professional bodies which also may have their own benevolent funds. Some of the area gas boards give a generous donation to the associations, and to give that money away to charity may cause some apprehension to the officers of those associations.

'My own view is that the juniors should focus their attention on the needs of the Fund as being responsible to the parent body to whom we have been affiliated for some eight years. The other difficulties will iron themselves out.'

The vote of thanks was accorded with acclamation. The Chairman thanked Mr. Wilson and Mr. Taylor on behalf of the Committee.

Mr. J. D. March (Power Gas Corporation Ltd.) and Mr. J. Haynes.

Mr. W. Oldham (Shropshire Division, W.M.G.B.) and Mr. S. Jones (Wolverhampton Division, W.M.G.B.)

Abstract of I.G.E. Communication 508

Gas Industry Finance

By WILFRID BAILEY, F.S.A.A., F.I.M.T.A,

CHIEF ACCOUNTANT, GAS COUNCIL.

THIS paper outlines the accounting methods used before vesting date and explains the method adopted for the gas industry after vesting date. Considerable space is devoted to the important question of provision for depreciation because of its effect on pricing policy. The author has presented some of the divergent views that have been expressed on the vexed question of whether provision for depreciation should be calculated on a replacement cost or an historical cost basis.

Throughout the paper, the Gas Act, 1948, is referred to as the Act.

In an industry employing a large amount of fixed capital represented by assets with long lives, such as the gas industry, it is doubly important that the right long-term financial policy should be pursued, particularly in relation to the annual provision to be made for depreciation. It is for this reason that a fair proportion of the paper is devoted to discussing the bases on which provision can be made for the renewal or replacement of assets.

There are two methods of accounting for fixed assets which the industry could have adopted. They are known as the depreciation (or commercial) method and the renewal method, which is generally represented by the double-account system. Under the renewal method, the balance sheet draws a sharp distinction between revenue and capital and, from the strictly theoretical point of view, disregards direct provision for capital wastage, provided that all renewals, repairs and maintenance are charged against revenue. This method assumes that capital is something which can be permanently maintained by renewal, and which does not change unless the undertaking itself expands or contracts. In the accounts, changes in price levels are ignored when capital assets wear out and are replaced, the cost of the new assets being charged to revenue. While the system has the advantage of clearly setting out the expenditure of capital upon fixed assets, it suffers from the inherent defect that such assets may not all be of a permanent kind, however thoroughly they may be maintained.

Depreciation Method

A recent definition of the depreciation method of accounting is:

'Depreciation accounting is a system of accounting which aims to distribute the cost or other basic value of tangible capital assets, less salvage (if any), over the estimated useful life of the unit (which may be a group of assets) in a systematic and rational manner.

Depreciation accounting, therefore, may be said to have two main objects:—

(i) to ensure that there is a charge to revenue of an amount estimated to represent, as closely as possible, the services rendered by the assets in the production of income, having regard to what the assets originally cost in monetary terms;

(ii) to ensure that in some measure, distributable profits are withheld to the extent of the provision for depreciation so that such withheld profits are in the business for the purpose of replacement, having regard, however, to the original cost of the assets in monetary terms.

Incidental to these two main objects, depreciation provides for the ultimate elimination of the asset from the books of account. It thus ensures that through charges to revenue a fund is in existence at the end of the life of the asset, ignoring fluctuations in prices, either to renew the asset or to repay the capital that financed the purchase of the original asset. The depreciation method was adopted by the gas industry because it was considered that it would ensure a proper charge against revenue each year for the use of the assets and would provide a steadier annual charge.

Rates of Depreciation

Once the principle of depreciation accounting had been agreed, there remained to be decided the rates at which assets should be amortised.

(i) *Pre-vesting Assets*

The boards agreed that where it was impossible to ascertain the written-down costs of pre-vesting assets, they would compute the provision for depreciation, on an average 'straight-line' basis, by reference to the estimated remaining serviceability of those assets as a whole. In the case of the former local authority undertakings, the remaining periods over which loan charges had to be met provided a ready measure of the remaining serviceability. Having regard to the information at its disposal, each board determined the period over which provision for depreciation was to be made. The boards are in each case satisfied that the amounts set aside are not less than would have been provided by the former undertakers which vested in them for renewal of assets, depreciation or debt redemption.

(ii) *Post-vesting Assets*

To ensure that the depreciation provided by boards on assets acquired or created after vesting date would be on a common basis, the Gas Council appointed a committee to recommend rates of depreciation. The report of the committee was adopted by boards, and the rates recommended therein are used for calculating, on the 'straight-line' basis the annual provision made in the accounts.

The question whether there should be a greater measure of self-financing by nationalised industries is still a very live one. Public criticism is frequently heard that these industries are making too great a demand for capital on the money market. The author outlined some of the main arguments that have been put forward during the past few years as to whether historical or replacement cost is the correct basis for calculating depreciation.

Much time and thought have been given to the question whether provision for depreciation should be calculated on an historical or on a replacement cost basis. To adopt the replacement cost basis would mean a complete change in the financial policy of the industry, with serious repercussions in prices. In considering this problem regard must be had, first to the fact that existing plant is not replaced with similar plant. Through the process of integration it is often possible to close small works and to make greater use of capacity that already exists in the larger works and which in the past has had to be retained as standby plant. In such cases, it may not be necessary to replace the plant closed down. But where replacement is necessary, small plants are being replaced by one or more much larger plants, thus enabling advantage to be taken not only of technical developments, but also of the benefits of large-scale production which substantially offset the increased capital charges for depreciation and interest attributable to the increased cost of plant. Secondly, as new assets are brought into use, they represent an increasing proportion of the whole and thus the depreciation provision of boards is progressively being calculated nearer to current price levels. Thirdly, boards

are liable for tax in the ordinary way, and, as only depreciation provisions on an historical cost basis are allowable for tax purposes, considerably more than the difference between historical and replacement cost of plant would have to be obtained from consumers through increased prices. In all the circumstances, boards felt that the strain of enhanced costs, which must be faced in the long run, should be taken gradually and without too violent a change in the price of gas.

The Provision of Capital

The provision of capital for the industry as a whole is the responsibility of the Gas Council, and, unlike the former companies, area boards have no permanent share or loan capital. Their financial requirements are met from the proceeds of redeemable stock issued by the Gas Council, from advances from the Ministry of Power, from temporary loans and from such internal resources as may be available at any time.

The Gas Council is authorised, with the consent of the Minister and the approval of the Treasury, to borrow money by the issue of British Gas Stock for the purpose of providing permanent capital for boards, and under Section 42(2) of the Act it may do so for any of a number of specified purposes.

The Gas (Stock) Regulations, 1949, made under Section 43(2) of the Act, require the Council to keep a redemption fund account, to which contributions are to be made each year during prescribed periods. Separate redemption fund accounts have to be kept for each issue of stock. The first contribution to each redemption fund account is to be made within 12 months, or, where contributions are made half yearly, within six months, from the first day of April following the date on which the stock is issued. The prescribed period for stock issued to date is 90 years.

While area boards have power under the Act to borrow temporarily, by agreement with the boards, the authority to borrow temporarily for the industry from the clearing banks is given to the Gas Council.

The following issues of British Gas Stock have been made since vesting date—

	£ mill.
(*a*) Issued in respect of compensation under Sections 25 and 30 of the 1948 Act, 3%, 1990-95 ...	189
(*b*) Issued for purposes authorised by Section 42 of the 1948 Act, on	
May 5, 1949, 3%, 1990-95	40
July 12, 1951, 3½%, 1969-71	75
August 7, 1953, 4%, 1969-72	80
July 14, 1955, 4%, 1969-72	100
	484

In addition, during the year 1956-57 advances from the Ministry of Power totalled £24 mill.

Area boards are required so to perform their functions as to secure that their revenues are not less than sufficient to meet all charges properly chargeable to revenue account, taking one year with another. These charges include, in particular, proper allocations to the Central Guarantee Fund and to reserve funds kept by the boards, proper provision for the redemption of capital, proper provision for depreciation of assets or for renewal of assets, and all payments due to local authorities for loans or advances.

The Gas Council is required under Section 46 of the Act to establish and maintain a central guarantee fund to be available should any board, or the Council itself, be unable temporarily to discharge its obligations for the payment of interest on, or the redemption or repayment of, any British Gas Stock or any temporary loan, or for any payment by way of compensation to a local authority.

The fund is not to exceed £5 mill. at any time and is to be built up by contributions from the boards, and from the Council if it borrows for the manufacture of plant and fittings. Subject to a maximum total contribution in any year of £1 mill., the annual contributions to the fund are to be determined by the Gas Council, with the approval of the Minister and the Treasury. If the Minister and the Treasury do not approve of the contributions determined by the Council, the Minister may himself, with the approval of the Treasury, decide the sums to be contributed to the fund.

The contributions to date to the fund total £2 mill., and no contribution has been made since 1953-54.

Boards are required by Section 47 of the Act to establish and maintain general reserve funds. The amount of the fund and of the contributions thereto are determined by each board and may be used only for the purposes of that board. Up to March 31, 1956, the boards had made transfers to general reserve funds totalling £5.6 mill. In addition to the sums placed to these reserve funds, boards also, during the same period, transferred from revenue an additional £3.9 mill. to replacement and obsolescence reserves, leaving a surplus balance carried forward on revenue account of £3.75 mill.

At the end of March, 1956, the general reserve funds stood at £5.6 mill., or 1.6% of gross revenue. The balance on net revenue account was £3.75 mill., and the two balances together represent 2.7% of gross revenue. The present financial position cannot be said to be satisfactory and, in my opinion, could not be claimed to be so until the amount of the reserves was at least treble the present figure.

Main Elements of Expenditure

Two important items of expense of boards are coal and wages, both of which have increased substantially since vesting date. A broad estimate of the cumulative effect on the industry as a whole, at current levels of output and efficiency, of the increases in costs that have taken place from vesting date to March 31, 1956, is £135 mill. This is made up of coal at pit, £50 mill.; freight charges, £10 mill.; wages and salaries, £30 mill.; other materials and services, £25 mill.; and capital charges, £20 mill. There has not, however, been any great change in the relationship of any of these items to the total annual expenditure.

It is sometimes overlooked that the gross income from products is now over half that from the sale of gas. The tonnage of coke and breeze sold in 1949-50 was 11 mill., and the average receipts per ton were 68s.; the corresponding figures for 1955-56 are 12.8 mill. tons and 114s. per ton. The question that springs to mind is whether the price of coke can be increased further without having a serious effect on sales, irrespective of whether any further increases might have to be met in the price of coal.

Capital Expenditure

The capital expenditure for the seven years from vesting date to March 31, 1956, totalled £319 mill.; thus boards are well on the way to trebling the capital value of their fixed assets. The total provision for depreciation, *etc.*, during these seven years amounted to £108 mill., of which more than one-third is in respect of assets acquired since vesting date. The increasing burden of the depreciation of post-vesting assets is evident from the fact that in the year ended March 31, 1956, the depreciation provision for post-vesting assets was considerably more than that for pre-vesting assets. Further, in 1956-57 it is more than double the provision for pre-vesting assets, and by 1959-60 it is estimated that it will be treble that for pre-vesting assets. Because the annual depreciation provision is deemed to include the repayment of principal of local authority loans and also the contributions payable to the stock redemption fund accounts, the whole of the sum of £108 mill. was not available to meet new capital expenditure. Broadly, the capital expenditure of £319 mill. was met by:

	£mill.	£mill.	Per cent.
Depreciation provision	108		
Sums set aside to replacement and obsolescence reserves	5		
		113	35
New Capital—			
British Gas Stock	242		
Less:			
Payment to local authorities ... 20			
Contributions to stock redemption funds used to purchase stock for cancellation 16			
	36		
		206	65
		319	100

Whereas the capital value of the assets of the industry rose from £204 mill. at vesting date to £523 mill. at March 31,

1956, the gas-making plant capacity of the industry increased by 21%.

Consequently, as would be expected, the annual capital charges—depreciation and interest—increased from £16.6 mill. to £38.3 mill. over the period of seven years, or from 1.9d. per therm of gas sold in 1949-50 to 3.5d. in 1955-56.

Between the first and the second world wars, the industry increased its sales of gas at the rate of approximately 2% per annum (compound). Since 1948, sales of gas have increased from 2,240 mill. therms to 2,649 mill. in 1956, an increase of 2.3% per annum. It is, however, in the industrial and commercial fields that the largest percentage increases have taken place, the domestic market having remained static. In 1948, domestic sales represented 61% of total sales, in 1955-56 the proportion had fallen to 51%; the corresponding figures for industrial sales are 21% and 28%, and for commercial and other sales, 18% and 21%, respectively.

Domestic Sales

When considering the scope for future development and the economics thereof, an important factor is the future rate of growth (or decrease) in domestic sales. While the number of consumers has increased slowly, the number of therms sold per consumer has decreased. Good reasons have been given for the fall in average consumption of gas per domestic consumer. Two valid ones are the increased efficiency of appliances and the improvement in the housing situation. Good reasons, however, do not sell gas nor reverse the trend of sales, and the cold facts must be faced. The principal cause of this decline, in the author's opinion, is the effect of competition from electricity, oil and solid fuel. Unless the relative competitive price position changes in favour of gas, it is impossible to forecast a big expansion in domestic sales; sales may or may not be held, or there may be a modest increase. The effect of the declaration of smokeless zones under the Clean Air Act, 1956, should help in the maintenance of sales in the domestic field, but in the end, price will play a vital part.

Of particular importance to the gas industry is the increase in the use of electric cookers and water heaters. It has been estimated that between 1948 and 1955 the new consumption attributable to these two appliances has accounted for anything up to two-thirds of the total increase of 7,000 mill. units of domestic consumption. It is not thought likely that the number of consumers will grow at anything like past rates.

The picture in the industrial and commercial fields is a happier one than the domestic field; industrial sales of gas have increased from 474 mill. therms in 1948 to 751 mill. therms in 1955-56, an annual percentage increase of approximately 6%. For certain loads in these two fields, oil is a keen competitor and the price relationship between oil and gas will play a vital part in any future expansion. On the other hand, the price of gas in these fields is lower than in the domestic field and any substantial switch from the domestic field to these two fields will mean a fall in revenue, which must be offset by reduction in costs rather than increases in prices.

A most difficult problem with which boards have to deal is the price of gas. With it is associated the structure of tariffs. All boards inherited a multiplicity of tariffs and prices, and the most that any board could attempt in the first year was to remove the most obvious anomalies in the prices charged for gas, and, so far as was practicable, to rectify the position where undertakings had been running at a loss. The next step was the introduction of tariffs uniform in structure as distinct from price. The general principle adopted was that, broadly, prices should reflect the cost of supply. With the introduction and extension of integration, it was possible to extend the territory over which the same price applied. Whereas at vesting date there were 1,037 separate undertakings, each with one, two or more price zones, by the end of 1956 the number of price zones of boards had been reduced to less than 100.

The application of the principle that, broadly, prices should reflect the cost of supply involves differentiation between consumers. A popular method of differentiating is according to volume of consumption by means of a block tariff, by which successive blocks of consumption are charged at progressively lower prices. This form of tariff is used to some extent by all boards; seven boards have one block tariff for all purposes, while the other five use it only for industrial and commercial consumers, domestic consumers having the option of a flat rate or a two-part tariff.

When considering the capital programmes for the years ahead, one cannot help asking what will be the competitive position of gas in the fuel market, say, in ten or 20 years' time. Any forecast of this position must be largely a matter of crystal gazing and should not be undertaken in a paper such as this. It has been demonstrated that the industry is not in such a strong financial position that it can afford to think it can weather any storm that may lie ahead. The industry has to compete with the electricity and oil industries, both of which are not only stronger financially, but in some fuel and power fields have no competitors and thus enjoy a monopoly. Electricity is an expanding industry and will continue to expand with increasing national production, if only because of its monopoly in certain fields. Therefore, gas is in an unfavourable position *vis à vis* its main competitor, and I suggest that unless cheaper methods of making or supplying gas can be found in the near future, gas will get little or no share of the expanding market.

Electric Encroachment

The paper indicates the inroads which electricity appears to be making into the domestic fuel market. What lies ahead? Can this encroachment be held, or will it gradually develop an impetus? On this subject, I would venture to proffer the view that price has not as yet been the all-important factor. I rank equally with price an efficient, sulphur-free supply of gas coupled with an adequate yet economical service to the consumer. Sales of gas follow sales of appliances. Sales of appliances will depend upon them being cheaper than, yet in design and efficiency ahead of, appliances available for competitive loads. The ideal is an all-gas domestic cooking and heating service, but to achieve this I feel that an answer must be found to the electricity two-part tariff. I suggest, if the competition that lies ahead is to be met successfully, it is most desirable that, within the next five years, the industry should place itself in a stronger financial position than at present through a greater measure of self-financing, which can only be met by increased efficiency or increased prices.

Generally, I would conclude that in the future it is going to become increasingly important that management should receive promptly financial and statistical information in a form that not only enables comparisons to be made, but trends to be detected. The degree of accuracy required will need to be assessed against the promptitude with which information is presented. Accounting documents contain a mine of information, but the time and cost of extracting it must be measured against the value it has to management. The developments that are now taking place in the accounting appliance field should lead to a greater use being made in the future of the data embodied in the primary accounting documents, which, in the past, it has only been profitable to extract to a limited degree. Just as I feel that there are exciting, yet exacting, days ahead in the technical field, so I feel this is true in the accounting field and that, in the years ahead, closer co-operation between all branches of management will be needed.

DISCUSSION

Mr. G. le B. Diamond, C.B.E. (West Midlands Gas Board) said that one of the most interesting sections of the paper covered the financing of the replacement of fixed assets. 'This is a matter which has assumed an importance which was unknown to a previous generation of accountants, owing to the effect of inflationary spiral which grows more and more onerous. Coupled with this, there has been the problem of financing the reconstruction of production plant, which was neglected during the war years, and for which insufficient depreciation has been accumulated. Moreover, there is the need to find vast sums of money for laying mains and services to large local authority housing estates, which often provide accommodation for citizens decanted from slum properties in town. The consequence of that policy has been to place a capital burden of unknown extent on the industry for the mainten-

ance of existing business. Mr. Bailey gives a most clear and comprehensive epitome of current thinking on this problem, which I hope will find a wide circle of readers and especially among those who are not intimately concerned with accounts, for it is only thus that an informed opinion can be created. It is of vital importance that the younger men should read this paper, because there is less and less opportunity of getting in touch with the accountancy and the commercial side now that we have more and more functionalisation.

'Attention is drawn to the remarkable revaluation of assets which was undertaken by Imperial Chemical Industries in 1950, and, from time to time, there have been suggestions that this method might be applied to the nationalised industries. It will be remembered that Imperial Chemical Industries, in 1950, revalued the whole of the assets at present-day costs so that depreciation could be set aside on the new valuation and could be dealt with as a charge in the balance-sheet which would appear above the line. The circumstances, however, in the nationalised gas industry are totally different, for Imperial Chemical Industries are working on a profit margin of probably between 30 and 40%, whereas the gas industry is operating at one-half of 1% margin; there would be no difficulty in the case of Imperial Chemical Industries in appropriating out of the profits each year such extra amount as appeared desirable and possible in order to set aside to supplement the depreciation charges. In other words, the provision for this replacement of existing assets could readily be provided by retaining some part of the profit in the business and for technical accountancy purposes this has been placed "above the line." By so doing, Imperial Chemical Industries have committed themselves to this basis of charge.

'Mr. Bailey remarks that to adopt the replacement cost basis for the nationalised gas industry would mean a complete change in the financial policy, with possible serious repercussion on prices. He goes on to say that "Boards felt that this strain should be taken gradually and without too violent a change in the price of gas." I very much hope that this policy will be continued, although I do think more will have to be provided for this purpose, and it can only be found by an increase in the revenue charge. We must not, of course, overlook the value of the provision of additional self-finance at a time when alternative borrowing costs 5% per annum for the next 20 years.

'The large shipping companies are very much in this trouble and, in some cases, ships which have gone beyond the normal span of useful life are being reconditioned. I think the gas industry may be forced to do something of this kind, and, after all, well-built modern plant should be capable of being kept in production by careful maintenance for a much longer span than the Evetts life.

'To sum up, therefore, on depreciation, I think (a) the gas industry will have to find more from some modest increase in gas prices, for I do not think that coke will stand any more; (b) good maintenance must ensure a longer life for the asset; (c) new methods of gas production, with much lower capital charges, may be just round the corner.'

Mr. Diamond went on: 'I will now pass to one of the most interesting aspects of the paper, namely, an independent view of the future of the gas industry and an analysis of gas sales in relation to electricity sales. I am not at one with Mr. Bailey in thinking that the fall in average consumption of gas per domestic consumer is entirely due to the effect of competition from electricity, oil and solid fuels. I had a look at this problem some time ago in connection with another matter, and I was astonished to find how many of us had forgotten what the average consumption of gas per domestic consumer was before the war. It is true, of course, that reliable figures for comparative purposes are hard to come by, but, through the courtesy of other boards, I have some information which I have had drawn on a graph, and I am handing it in as part of my contribution in the hope that it may be reproduced in the Proceedings.'

Mr. George E. Currier, O.B.E. (Deputy Chairman, North Eastern Gas Board): 'Our congratulations are due to Mr. Bailey for his lucid account of the finances of the nationalised gas industry. There is very little to criticise in his paper. On the other hand, one must admire his realistic approach to the competitive position of gas in relation to electricity and oil. Four years ago I made similar comments on the state of our industry and the problems confronting us. It is ominous to find that those remarks are even more applicable today.

In the interim our coal costs have continued to rise more steeply than those of our competitors, and with them, of course, the prices of gas and coke. True, a number of new gasmaking processes are being developed, but it is still too early to assess whether they will produce a cheaper therm. The use of tail gases from oil refineries has increased, but the search for natural gas has revealed no considerable reserves, and attention is now being given to the importation of natural gas from other countries.

'The recent Suez crisis has underlined the weakness of relying upon oil and oil products. We would be in a happier position if the cheaper therm could be produced from our indigenous raw materials, but it seems that the substantial fall in coal prices essential to a reduction in the cost of gas manufacture is most unlikely to occur. We are, therefore, driven to seek these new sources of gas and new processes, many of which rely on imported raw materials.'

Mr. G. A. Howard (Chief Accountant, East Midlands Gas Board), said that the author had stated: 'I would conclude that in the future it is going to become increasingly important that management should receive promptly financial and statistical information in a form that not only enables comparisons to be made but trends to be detected.

'In his paper, Mr. Bailey has certainly followed his own dictum,' said Mr. Howard. 'He has made comparisons and he has detected trends. Most of his external comparisons, however, are with electricity and coal. No doubt because of the difficulty in obtaining really comparative statistics for oil, it has not been found possible to include figures for this important competitor.

'It is probable that some will feel that the paper paints too sombre a picture. I think it is generally true to say that accountants are not given to easy optimism—perhaps this is one of their main uses in the ever recurring battle between the desirable and the possible.

'Some of the general conclusions are expressed in the form of questions, and, quite candidly, it is difficult to see how they could have been expressed otherwise. Nevertheless, the final chapter of the paper contains certain positive views and from these I would like to select one which, in my opinion, is very important, because, although it is stated in financial terms, its implications are economic.

Stronger Position

'I quote: "I suggest, if the competition that lies ahead is to be met successfully, it is most desirable that, within the next five years, the industry should place itself in a stronger financial position than at present through a greater measure of self-financing, which can only be met, wholly or in part, by increasing efficiency or increased prices."

'Very few would disagree, least of all accountants, on the general desirability of building up a stronger financial position. Where opinions may differ, however, is in the selection of a suitable yardstick for measuring the strength of the financial position of an organisation such as the gas industry.

'It is a nationalised industry; the due service of its capital stocks is guaranteed by the State; its monopoly characteristics are declining and it faces severe competition; nevertheless, it must continue for a long time to provide service to its consumers. In other words, the financial status of the industry may be somewhere between that of a private enterprise industrial organisation and a public service. I would be glad to have Mr. Bailey's more detailed views as to what, in his opinion, constitute the essentials of a strong financial position in an industry such as ours. My own feeling would be that the strength of the financial position would be measured by the degree to which it is shock-proof to the various adverse factors which may occur from year to year.

'In the financial affairs of industrial organisations we are sometimes faced with the paradox that periods of prosperity often go hand in hand with a shortage of money, whilst adversity is often accompanied, and indeed signalled, by an accumulation of cash funds or reduced borrowing requirements. This point is, of course, referred to in the paper.

'I think, however, that these factors should be borne in mind when framing a financial policy and would support a plea for less rigidity in the industry's borrowing arrangements, so that financial requirements may be balanced against

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prevailing conditions and the skill and knowledge of the financial officer used to the greatest advantage.'

Mr. W. Hodkinson, O.B.E. (Deputy Chairman, North Western Gas Board): 'Many of us will remember his most interesting contribution to our knowledge of these subjects in the paper he presented to us in Bournemouth some three or four years ago, and it is interesting to recall that he then raised a warning as to the possible effect of our capital regroupment programmes on the future economic situation of the industry.

'At that time, as engineers responsible for the maintenance of gas supplies to our consumers, we were not slow to remind Mr. Bailey of the urgent need for such regroupment, and I believe that he has since come to realise that we were not embarking on a mad capital spending spree but rather on a programme of planned development designed to achieve positive results for the consumer and the industry. Indeed, the Gas Council's seven years' results brochure, possibly prepared by Mr. Bailey's office, pays tribute to the success of our planning efforts and I believe there are still some more dividends to come.

'In the paper today, Mr. Bailey quite rightly raises several warnings, and I suggest that he has raised them in the right quarters, because I am satisfied that only the engineer can find the answers to the problems so clearly indicated in the paper.

The Maximum

'In my view, our present basis of capital depreciation represents the maximum that the consumers of today should be called upon to bear; for the future it behoves the industry to provide the means of withstanding inflationary pressure such as may arise by improving its efficiency and the productivity of its labour and capital assets.

In the North-West we have held this view for some time, and indeed our interest initially in the Rochdale process sprang from the need to reduce the effect of capital charges.

'It is of interest to record that in reporting the improved productivity of our existing plants by integration and the improvement of our efficiency, in our paper we were in fact recording a saving of some £12 mill. in capital expenditure or, if you like, a hidden depreciation write off of some £12 mill. in seven years.

'For the future, and the very near future, I will count our engineering and development efforts a failure if we cannot find means of substantially increasing the productivity of our capital expenditure, using new techniques now becoming available in every field of our activity.

'I have, however, an academic interest in the economist's theory of replacement cost, and to that extent I am interested in the hypothetical case of a board which is offered substantial quantities of relatively cheap gas from an external source on a period contract and proceeds to develop a system for its disposal. Perhaps Mr. Bailey could tell me what would be the economist's suggestion for such a board. Would the suggestion be that such a board should under the replacement basis build up a fund to provide for plant to cover the eventuality of the contract not being renewed—in other words, to sting the poor old consumer for double depreciation?

'I repeat that I have only a passing interest in the economists' theory because I do not believe for one moment that we or the nation can afford the extravagances which stem from the lush economy of the two industries mentioned in Mr. Bailey's paper. It is all too easy to pass a charge to the consumer, and as a monopoly you might get away with it, but as a competitive trader, as we are, we would finish up a very healthy corpse!

Expansion

'The second warning in Mr. Bailey's paper is the more serious, and it is evident that he agrees with our contentions of yesterday, namely, that unless cheaper methods of making and/or supplying gas can be found, and in the not too distant future, gas will get little or no share of the expanding markets which must follow a national expanding economy, and this in spite of the fact that in the national interest the country's indigenous fuel resource, coal, should play its part in the expansion via processing industry.

'Again, I would say that if the engineers of this great industry of ours cannot find the answer to this problem, they will fail miserably—and I do not believe that to be possible.'

Mr. H. R. Hems (Consultant) referred to the table on page 5 of the paper and Mr. Bailey's comments on sales, including industrial sales, and the future. 'The table contains the results of the seven formative years of nationalisation,' he said. 'So far as the industrial load is concerned, some of us feel that that could have been a greater story, but there is no doubt that the difficulties inherent in early nationalisation, particularly the shortage of gas in certain boards, had an adverse effect on those figures.

'In spite of Mr. Bailey's earlier remarks regarding accountants in introducing the paper, I would very much like to pay a tribute to Mr. Bailey and to the Chief Accountant of the West Midlands Gas Board, for the ready appreciation and consideration which they gave to me and to my colleagues when it was my responsibility to maintain and extend the large industrial load in the West Midlands and endeavour to guide the activities of the Industrial Committee of the Council in the wider fields affecting the other boards.

'I would like to ask Mr. Bailey, now that we have, after continued investigation, a more detailed knowledge of the breakdown of the gas loads, whether a further investigation of the costs of distribution and sale affecting each separate load—domestic, commercial and industrial—might be worthwhile in assessing prices in order to retain existing and attract new business. I know that in the end it has got to be balanced up, but I do feel that there is a case for knowing a little more about the true costs of the individual loads.

'So far as the industrial gas load is concerned, a certain proportion, not specifically known, I think is reasonably secure. Another is comparatively competitive, and the remainder, probably covering the greatest possibility of expansion that exists, is definitely competitive. These two latter portions are where I think a closer analysis of costs might be the most valuable.

'The industry must be and will be, I am quite convinced, increasingly called upon to meet demands for industrial fuel in the future. The recent oil crisis has pinpointed and shown it up, and I am quite certain that in the expanding economy of the country it must be prepared to meet a greater portion of the industrial fuel requirements.

'I dared, in 1945, after reviewing the industrial activities of the war, to predict a rising industrial load within an expanding total sale. The former is operating, but, as I think is evident from the discussions of the last two days, the later is not quite so good. Mr. Bailey has pinpointed this, and I think we all owe him a great debt of gratitude for that. He has gone further and indicated some of the ways in which that might be overcome.'

The President asked Mr. Bailey to reply in writing.

Mr. G. F. Freeman (Caltex, U.S.A.) talks to G. F. Oliver, Deputy Chief Engineer, S.W.G.B.

Mr. J. P. Smith (Meters Limited) with Mr. G. F. Kelly (Metropolitan Meters).

Abstract of Communication No. 509

The Application of Work Study in the West Midlands

By. H. B. BASSETT, M.A., B.Sc., Assoc.M.Inst.Gas E.,
Work Study Officer, Birmingham Division,
and W. J. G. BRYCE, Assoc.M.Inst.Gas E.,
Work Study Officer, Walsall Division.

WORK study is the objective and systematic application of the art of good management in order to increase productivity and operational efficiency. It attains this end by the better use of plant and equipment, raw materials and manpower. The gas industry has made steady progress for many years in improving its technical productive processes, and the stage has been reached when it seems unlikely that greatly increased thermal output or efficiency can be attained with the present gas-making plants. Unless there is some revolutionary discovery, therefore, the only ways open to cheapen the cost of gas production by the orthodox processes are either to purchase coal and oil more cheaply, which seems unlikely, or to obtain a larger thermal output per employee.

Clear Understanding

With these thoughts in mind the West Midlands Gas Board in 1951 commenced making enquiries of industrial firms in the Midlands, and also of business consultants with a view to introducing work study. Due to the specialised nature of the gas industry, the Board appointed from their own staff six officers for training. The paper gives an account of the training and the action taken by the Board to ensure clear understanding by management and the Trades Unions.

There is a popular belief that the aim of work study is to make people work faster and gradually turn them into automata. Work study represents neither of these aspects. It is in fact the systematic, objective and critical examination of all factors governing the operational efficiency of any specified activity in order to effect improvement. Two techniques are used and they are inter-dependent, though for convenience they are described separately, as 'method study' and 'work measurement.' The objective of both techniques remains, increased productivity from the same or smaller use of existing resources.

Method study is defined as the critical examination of existing or proposed methods. In its application the prime considerations are the elimination of unnecessary work, combining and re-arranging what remains and simplifying wherever possible. A basic logical procedure, of 'select, record examine, develop, instal and maintain,' is followed and the steps are described in detail.

The second technique, work measurement, may be defined as the systematic determination of the proper time to allow for the effective accomplishment of a defined task carried out to a specific method. It makes use of various timing techniques, the most common of which is the stop watch. It aims to provide factual knowledge of the time necessary to complete a task and the effort required of the operator.

Few employees of the area boards actually accomplish 60 clock minutes of effective work in the hour during an average day. The aim of work study is to determine why this is not achieved, what can be done to rectify the position, and if possible to ensure that this figure is attainable, and, if exceeded the individual is financially rewarded for the increased effort.

So work measurement, following method study, can supply management with factual and accurate information on economy in manpower, alternative methods and also information leading to more accurate budgeting, better labour costing and the provision of equitable incentive payment schemes. In the paper, the method of developing and building up time values, calculating labour performances and applying incentives are described in detail.

No Substitute for Good Management

By itself, work study can achieve nothing. It must be emphasised that it is no substitute for good management, and is an integral part of good management. Its method of application is of paramount importance since it deals with human beings. The self respect of the individual must be assured and his intelligence enlisted for the furthering of productive efficiency. This can only be done by the fullest support of and appreciation by management, close consultation with the Trades Unions and an appreciation of the worker's fear of the unknown. If these factors are borne in mind, then no person can reject the objectives of more individual satisfaction and increased productivity.

DISCUSSION

Mr. G. le B. Diamond, C.B.E. (Chairman, West Midlands Gas Board): 'Upon the nationalisation of the gas industry, it became painfully evident that the West Midlands Area was woefully short of manual operatives and of staff for the urgent task in hand. The Board sent the Deputy Chairman and a recruiting party to Ireland and South Wales in an attempt to repair the deficiency. Moreover, at a cost of nearly £40,000, a hostel was built for the reception of single men prior to lodging accommodation being found for them. It was soon found that our efforts had formed a new and free agency for providing manual workers for the motor-car industry and this form of recruiting had to be abandoned.

'Naturally, the question immediately arose "What can be done, and why do men prefer to go to the vehicle building and other manufacturing industries rather than stay in the gas industry?"

'You will have seen that quite early on the Board took the decision that the only proper way of tackling this subject was to train our own staff and this has been done, we believe, very thoroughly. With the aid of Imperial Chemical Industries, and other leading industrialists, together with the Loughborough College of Technology, we have trained some of the most promising of our younger engineers so that they may devote themselves whole-time to this important work, although it is not the intention of the Board to keep these young men permanently on this work.

'I have no doubt that some people will say that "work study" is new jargon for the old subject of good management but they will be quite wrong. It is a totally new approach to the method of doing a job and the manner in which it shall be paid for. Method comes first and that only proceeds from a logical analysis of the job to be done, the payment being based not upon time spent on the job but upon the work done.

'Work study needs practical study in

the field after a course of theoretical instruction and, before its application anywhere in the gas industry or elsewhere, a very large number of relevant factors must be taken into account. On the production side, the manning of retort houses immediately occurs as one of these items. It would be possible to set a stint that was too high or too low and both evils would be fraught with much trouble. If, however, the work study officers have been well trained, it will be found that their assessment of the job value and the stint will match up one with another when an independent valuation has been made. Nevertheless, care has to be exercised or otherwise more could be paid for a given job of work than is really necessary.

Results

'The most likely questions to arise from the examination and discussion of this paper are "What results are you having in the financial sphere?" and "Is it worth while from the gas industry's point of view?" It will not have escaped observation that financial figures have been excluded and they have been deliberately left out. Only harm could ensue from comparisons between one place and another, without relation to different conditions. In general terms, however, I can say that the results so far are promising to the consumer, to the operative staff, and to the Board.

'We have not yet attempted to work study gas-fitting, mainlaying, mechanical maintenance, or meter collection, although, in the case of the latter, we have some useful incentive schemes running. On the other hand, you will find detailed in the case history an interesting investigation of meter testing and repairing.

'To sum up, let me say that our experience has shown that there is a definite advance in productivity per employee, which is the thing that matters. I should like to congratulate the authors on the preparation of an excellent paper.'

Mr. G. H. Kenyon (South Eastern Gas Board): 'It seems to me that if the industry is to give real effect to the Resolution of the Joint Conference with the trade unions in October, 1953, concerning efficiency, there must be a joint understanding of work study and its potential, and a joint enthusiasm to make its application successful.

'In his fairly recent survey of industry in this country, Aidan Crawley found work study very often resisted more by middle management than by the men. On the other side, the men have got to do the work that has been studied, and the trade unions are watching their interests. Here again, success for work study requires full understanding, confidence, and trust the whole way through. The mainspring of resistance is fear, of course—fear of change and fear of redundancy. This fear must be allayed by precept and example. It is necessary on occasion to delay the introduction of a scheme to allow natural wastage of manpower to overtake the potential redundancy. In a word, work study requires a climate of partnership—a partnership of management, the men and their representatives. The climate is set fair when management, including foremen, are pressing for the service of work study and the men, on the other hand, are also knocking on the door asking for it.

'I should like to suggest further co-ordination between boards, however limited for the time being their entry into the field of work study may be, by periodic meetings of representatives. There is bound to be a great deal in common. In addition to the exchange of information on studies of similar operations, comparing problems and difficulties as well as successes, co-ordination between boards could very well accelerate tremendously the build-up of standard data for the purpose of synthesis.

'In considering productivity, I would add to the authors' list of basic resources the item of capital. They indicate the advantage of applying work study in the design stage of a project. While contributing towards operational efficiency in the use of men and materials, there can also be the opportunity for substantial economies in initial capital investment. By admitting work study to the drawing office, alterations are a matter of rubbing out lines on a piece of paper, which is somewhat different from altering the lines of steelwork or reinforced concrete after erection.

'In the application of work study, there are two things which should be kept "pure," so to speak. First, the basic rate for the job, the hourly rate that is, must recognise only the skill inherent in the job and must not take account of associated conditions. It is true to say that the work study officer has no part in fixing this rate. Secondly, the rate of working should be assessed without the "contamination" of such considerations as the conditions of the workplace, temperature, and so on. These factors are properly taken care of in subsequent "compensating rest" and "process" allowances.

Expansion of Activity

'Incentive bonus payments figure rather prominently in the paper. I would emphasise that work study of itself only provides "allowed times" as a basis for incentive schemes and that work study can do nothing for existing "loose" bonus or piecework rates except to reveal the horrid truth. Furthermore, a very great deal can be achieved with existing operations by method study alone, without work measurement and incentive schemes.

'Our own results have led to an expansion of activity. A limiting factor, however, is the time taken to get additional staff trained and competent to work on their own, especially if they are recruited from within the Board, which we prefer, are entirely new to work study and, in these early days, are joining only a small establishment of experienced staff.

'Again, like the West Midlands, the South Eastern Joint Industrial Council and the Joint Standing Committee for Intermediate Grades have formal agreements for the application of work study. We feel, however, that probably the biggest potential for savings on gasworks is in the organisation of the work of maintenance craftsmen on the basis of planned and preventive maintenance. To that end, we are busy building up schedules and data.'

Mr. H. W. Moys (North Thames Gas Board): 'The introduction of incentive schemes is one of the way in which we can reduce production costs. For an incentive scheme to be successful there must be greater productivity and thereby a reduction of manufacturing costs; there must also be labour economy. Method study is particularly important in the design of the plant and in my own Board has always resulted in a more economical working and a reduction of the labour required to operate the plant.

'In my Board we have had incentive bonus schemes operating for many years but I cannot claim that they have been introduced after a very detailed work study such as the authors have put before us. The working standards on which the bonus is paid are assessed by the labour relations officer staff and these are essentially for the whole of the Board.

Coke Bagging

'We first introduced an incentive scheme for coke bagging in the early 1900's and this has been steadily developed and various changes made as the methods of handling coke have changed. At the present time in the majority of our loading bays three-men gangs are employed and they normally cope with 100 tons per gang per day and this work does not employ them for the entire eight-hour day.

'Then, in order to interest the delivery drivers, we introduced bonus payments for the delivery of coke. Initially this was based on a tonnage basis and the mileage covered, and subsequently changed to produce a larger bonus after a standard tonnage had been handled. At a later stage, we altered it again to a straight piecework system which we are now using.

'With regard to locomotive operation, we have had incentive schemes operating at our larger works for this duty for quite a large number of years and these are based on the tonnage handled. In our meter department, for meter testing and repair, we went into the question of the introduction of an incentive bonus after the end of the last war and subsequent to its introduction we have got an increase of output from that department of some 20%.

'Some year or so ago we employed a firm of consultants to study the duties of meter readers. We subsequently introduced an incentive bonus scheme on one of our divisions. The method of payment for this scheme was based on the savings that would result when the meter reader exceeded a standard work unit. The resulting saving is passed largely to the meter reader himself while a small proportion remains

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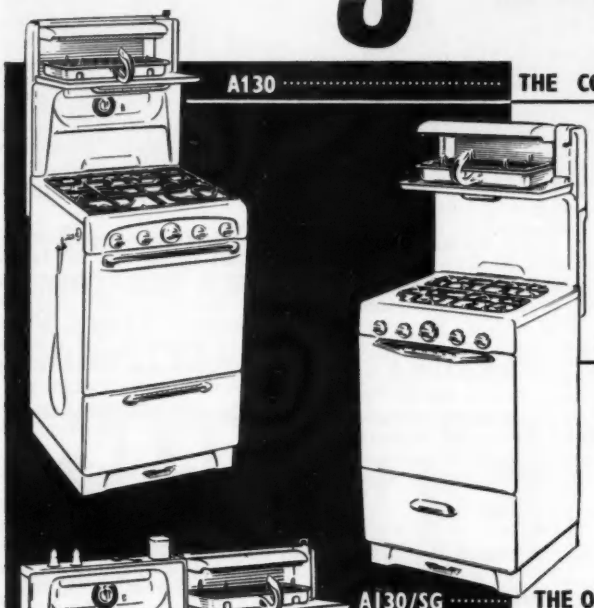

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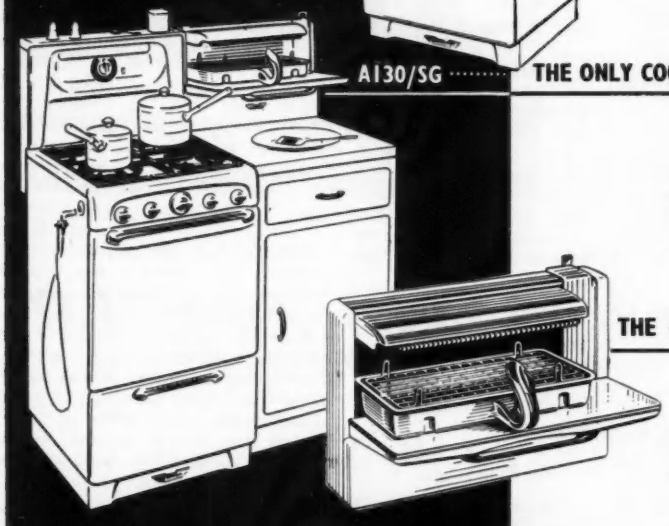

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with the Board. We have followed this up by the introduction of a similar incentive scheme for the pre-payment collectors.

'Our experience, I think, does indicate that any form of incentive scheme should relate as nearly as possible to the individual's output and that if you do, having introduced a scheme, subsequently alter the plan, its new terms should be negotiated as rapidly as possible.

'We have considered the application of work study and incentive schemes to mechanical maintenance. It is, I think, a very difficult problem because some of the more unpleasant conditions in the mechanical department are very difficult to apply incentive schemes to. We are experimenting on a very small scale with one trade at our largest works.

'In the case of retort houses the quantity of work to be carried out is fixed and the nature or character of the work which the individual stoker has to carry out depends on a number of factors, particularly the life of the retort house and the type of coal being handled. In the case which the authors set out one would have expected, I think, that where the discharging duties of two men were concentrated on one there would have been pressure for the equivalent of double pay to be given to the one operator and this in turn might disturb the other retort house men whose duties could only be increased to a lesser extent.

Changing Structure

'The adoption of widespread incentive schemes, however, will finally change the wages structure of the Board, and once introduced it will be very difficult to revert back to the old system. They therefore must be introduced as a result of very careful and thorough study.'

Mr. W. A. P. Hoskin (Barnsley): 'The aim of work study is, of course, to increase productivity, and the paper we have had presented to us this morning one might say introduces the application of work study to the gas industry.

'So easily, however, do we introduce into everyday usage a word or term which very quickly becomes hackneyed. This is almost true of the word "productivity" since the introduction of productivity committees throughout the country. What it really means to the gas industry is that either production is increased at an economic rate or the industry will decline.

'Work study means the study of the man and the job he does and the aim is to increase productivity. But it is the study of man which comes first. The man is a human being—an individual. I venture to say that one of the most difficult accomplishments in industry today, if not in society, is to be an individual, yet it is the most important factor which must remain uppermost in the consideration of this subject of work study. It is evident that this is fully appreciated by the authors.

'The very strong point in the authors' approach to the subject is what they term common sense, and this is a natural prelude to success. One is therefore not surprised to learn that in the coke bag filling experiment the labour

The authors of 'Work Study' have a brief conference.

turnover is virtually nil and that the men employed are probably the most contented employees in the Birmingham works.

'It is also true that in work study the industry has an effective means by which the trade unions can help in the increase of efficiency in many ways. It would be of interest, therefore, to learn the extent to which co-operation exists between the trade unions and the work study team.

'The value of the paper to me is the freshness of approach to a most important study.'

Mr. J. W. Holdaway (Eastern Gas Board, Watford Division): 'I have been employed solely on the supply side of the industry, and I am confident that the work content of many aspects of district fitting work can be measured and placed on incentive. It is encouraging, therefore, to hear that the West Midlands Board has decided to tackle the problem of maintenance both on the works and the district.

'The West Midlands Board is now set to explore fresh fields, to decide upon the best subjects to tackle, and the most suitable techniques to employ. Several other boards have appointed work study officers and no doubt they are in the same position.

National Policy

'With the application of work study in the gas industry still in the embryo stage, a definite national policy should be adopted. First, a nucleus of fully trained work study officers should be established, and having gained sufficient experience they should decide upon the best method of training our own personnel in this subject. A central training school should then be established.

'Second, liaison between the boards should be established to ensure a regular interchange of ideas and pooling of information. This is a new venture for our industry, and in the interests of efficiency it is essential that there should be full co-ordination of effort.'

Mr. S. C. Herbert (South Eastern Gas Board): 'I should like very much to add my support to those who have mentioned the question of work study in design. I feel that it is a very important point to bear in mind that we should be sure that any design and construction work in hand fulfils the needs of the works before it is built and to be sure that the men use it to the best advantage when it is completed.

'There are two very small examples I should like to mention on design work. Have you ever thought how much it costs when a lorry is standing waiting to be unloaded and how much time is spent by the driver in releasing the tailboard and securing it again after tipping? There are lorries available with tailboards controlled from the cab, and let us not forget that the purpose of a lorry is to move its load. Standing time is unproductive time, and is a liability to the job.

'With regard to the transport of liquids, what is the size of the outlet connection on the usual road tanker? Not more than 3-in. How long does it take to empty it? I suggest that rather than put in pumps or use compressed air for unloading we should have connections on these tankers which are very much larger. Gravity would do the job for us with savings in time of up to 50%.

No 'Panic'

'In one of the plants of my Board we recently introduced work study techniques to guide the maintenance engineer in planning his work before a particular major overhaul was started. The department followed the job right through, in close touch with the foreman of all trades, and the final result, compared with the previous overhaul, which was only observed to gain information, showed a reduction of "down"-time of 30%. There was a more uniform level of employment right through the repair, a considerable reduction in waiting time between jobs, because the men knew individually beforehand the sequence of work they were to tackle, and the cost of the job remained about the same in spite of increases in wage rates over the intervening three-year period, and for a somewhat greater quantity of work done. Furthermore, there were at no time during the course of the work any "panic" rushes to get work done which had been overlooked.

'In another of our works method study reduced locomotive working time by 50% and made redundant a number of rail tanks. In a case of the loading of naphthalene into ships, about half the number of men are now employed for half the original time and two lorries and one crane have been dispensed with. Painting and scaffolding work is carried out at two of our works on a full-time basis and these jobs are the only ones which are run continuously so far on a work studied incentive bonus scheme. One outstanding result of the scheme has been the decrease in overtime working necessary from 80-90 hours a week to 100 hours in 15-16 months, but occasions do arise when local conditions will not permit the full realisation of economies offered by work study, and we have several schemes in being which have been shelved for the time being.'

Mr. W. J. G. Bryce, in reply, said they had been asked a great many questions and would reply to them all in writing in due course.

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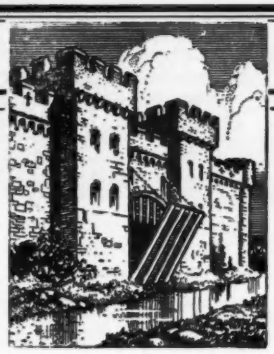

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The " Gas Journal " is published every Wednesday, price 1/6d.; by post 1/8d.

Subscription Rates:—65/- per annum; (Payable in advance.) A copy of the " Gas Journal " Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at 2/6 per line (approx. 7 words)—minimum charge 10/-. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10 in. deep × 7 in. wide; block screen 120.

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NORTHERN MANAGER: Philip W. B. King, Flat 1, 7 Langcliffe Avenue, Harrogate. *Telephone:* Harrogate 67625.

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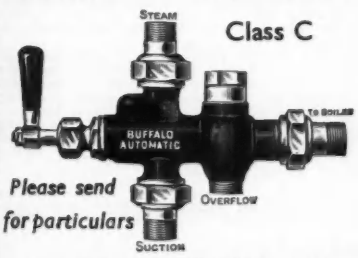

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FOR SALE.—One unused 48 in. all C.I. Sluice Valve by Glenfield. Flanges 55½ in. diameter, 28 holes, 53½ in. P.C.D., 2 ft. 3½ in. long. Cleckheaton Engineering Co., Ltd., Cleckheaton, Yorks. Phone 397.

SPECIAL OFFER: Large quantity of new cast iron fullway valves, all iron parts, 8 in., 10 in., 12 in. and 14 in. for sale. The Midland Iron & Hardware Co. (Cradley Heath) Ltd., Cradley Heath, Staffs. Tel.: Cradley Heath 6264 and 5.

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RIVETTED Steel Mains, 60 ft.—5 ft. 4 in. dia. Welded Steel Mains. Approx. 250 ft. × 36 in. dia.; approx. 150 ft. × 30 in. dia.; approx. 100 ft. × 21 in. dia. Good secondhand condition. Maden & McKee Ltd., 317, Prescot Road. Liverpool, 13.

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REQUIRED: One Second-hand Carburetted Water Gas Plant in working condition able to produce a minimum of 1½ mill. cu.ft. per day.

Offers, giving full details of type, age and location of plant, together with indication of price required, are invited immediately to No. 325, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

APPOINTMENTS VACANT

ENGINEER familiar with the gas and/or coke-oven industry and works practice, who can write clear and concise English, required as assistant to the editor of a monthly technical journal. No. 323, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

PROJECT ENGINEER required to join expanding Company at the Head Office in London on work connected with Coke Ovens, and By-product Chemical Plant. Appointment will suit man of about 30 years of age, with sound engineering background, preferably in these fields of activities. Starting salary commensurate with qualifications. Apply quoting reference ICS, No. 324, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

NORTH THAMES GAS BOARD

SENIOR DRAUGHTSMEN are required in the Chief Engineer's Department at Westminster, S.W.1, for:—

(1) The design and layout of general process plant and all associated structural steelwork.

(2) The design and detailing of civil engineering, foundations and structural work mainly in reinforced concrete associated with gas manufacturing plant.

Candidates should preferably be Corporate Members of the Institution of Civil, Structural or Mechanical Engineers.

Starting salaries within the range £890-£1,050 per annum according to age, qualifications and experience.

The successful candidates will be required to join the Staff Pension Scheme.

Applications, giving age and full particulars, should be sent to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, W.8, quoting reference 666/314.

NORTH WESTERN GAS BOARD

WIRRAL GROUP
MECHANICAL SUPERINTENDENT—
BIRKENHEAD

APPLICATIONS are invited from suitably qualified persons for the above pensionable appointment at a salary within Grades A.P.T. 8/9 (£745/£895 p.a.) according to qualifications and experience.

The person appointed will be responsible to the Station Engineer for the maintenance of mechanical plant and buildings on the works, for which purpose he will have charge of a suitable staff and workshop facilities.

Application forms, together with further details of the post, are obtainable from the General Manager, N.W.G.B., Wirral Group, Hind Street, Birkenhead, and should be returned by Thursday, June 6, 1957.

WOLLONGONG GASLIGHT CO., LTD.

APPLICATIONS are invited for position of WORKS SUPERINTENDENT, Wollongong Gasworks, Australia (annual output 250 mill. cu.ft. in W-D continuous vertical retorts).

Commencing salary £1,400 (Australian) per annum.

Steamer fares in one-class P. & O. or Orient Line ship will be paid by Company for appointee and his family. Company will also assist with housing in Wollongong.

Superannuation scheme available.

Salary to commence from date of embarkation English port.

Applications to be forwarded care of William Coward & Co., Ltd., 3, St. James's Square, London, S.W.1, not later than May 30, 1957.

(*Classified advertisements continued on page* 488)

APPOINTMENTS VACANT (ctd.)

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
ASSISTANT CHEMIST,
NEEPSEND WORKS

APPLICATIONS are invited from suitably qualified persons for a position as ASSISTANT CHEMIST at Neepsend Works, Sheffield.

Salary will be in accordance with Grade APT. 7 (£705/£785) of the National Salary Scales and placing thereon will depend upon qualifications and experience.

Candidates should be experienced in the analysis of coal, coke, oil, gas and by-products.

The person appointed will be responsible to the Works Senior Chemist for the organisation and control of sections of the laboratory work and should possess the Higher National Certificate in Chemistry or equivalent.

The position is pensionable and the successful applicant will be required to pass a medical examination.

Applications, giving details of age, qualifications and experience, together with the names and addresses of two referees, should be forwarded to reach the undersigned not later than June 3, 1957.

C. C. WOOD,
Divisional General Manager.

Commercial Street,
Sheffield, 1.

EAST MIDLANDS GAS BOARD

NOTTS. & DERBY DIVISION
RESIDENT FITTER/HOLDER STATION ATTENDANT, MELBOURNE

APPLICATIONS are invited from Gas Fitters for the above position.

The post is graded on Intermediate Grade VII Provincial 'A' (£605/£650 per annum) with Class II Conditions of Service.

The successful applicant will be responsible for the operation and general maintenance of the Holder Station, will be required to deal with gasfitting work including attention to emergency calls outside normal hours, and to attend at the Showrooms on two afternoons per week.

The applicant's wife will also be required to carry out certain duties.

A house will be available at the Holder Station on a Service Occupation Agreement.

Applications stating age and experience and giving the names of two referees, should be addressed to the undersigned not later than Monday, June 3, 1957.

K. L. PEARCE,
Divisional General Manager,

East Midlands Gas Board,
Notts. & Derby Division,
P.O. Box No. 62,
Friar Gate,
Derby.

EAST MIDLANDS GAS BOARD

NOTTS. & DERBY DIVISION
ASSISTANT ENGINEER—CHESTERFIELD DISTRICT

APPLICATIONS are invited for the above appoint- ment at Chesterfield.

The works distributes approximately two and a half thousand million cubic feet per annum, of which five hundred million cubic feet is made in horizontal retorts and carburetted water gas plants and the remainder is purchased from coke ovens supplying into the grid system.

Applicants should possess the Higher Grade Certificate in Gas Manufacture of the Institution of Gas Engineers and must have had experience in the operation of horizontal retorts and water gas plants and possess ability to control labour.

The appointment will be made within Grades A.P.T. 8/9 (£745/£895) and the commencing salary will be dependent upon the qualifications and experience of the successful applicant.

The post is pensionable and the successful applicant will be required to pass a medical examination.

Applications, stating age and giving details of education, qualifications and experience, together with the names of two referees, should be addressed to reach the undersigned not later than June 3, 1957.

K. L. PEARCE,
Divisional General Manager,

East Midlands Gas Board,
Notts. & Derby Division,
P.O. Box No. 62,
Friar Gate,
Derby.

EAST MIDLANDS GAS BOARD

HEADQUARTERS
ASSISTANT TECHNICAL OFFICER (UTILISATION)

APPLICATIONS are invited from suitably qualified persons, preferably with an appropriate University degree, for the above appointment in the Commercial Manager's Department.

The successful applicant will be required to work in the Appliance Research Centre at Syston, near Leicester. The work of the Centre includes the assessment of district performance of domestic gas and coke appliances, fittings and meters. It deals also with commercial gas appliances and assessment of coke quality.

The salary will be within Grade A.P.T. 11 (£895/£1,020 per annum) of the National Salary Scales for Gas Staffs. The position is pensionable and the successful candidate will be required to pass a medical examination.

Applications stating age and giving details of qualifications and experience, together with the names of two referees, should be addressed to reach the undersigned not later than June 10, 1957.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road,
Leicester.

May 17, 1957.

SCOTTISH GAS BOARD

GLASGOW & WESTERN DIVISION.
TECHNICAL ASSISTANTS.

APPPLICATIONS are invited for a number of appointments as TECHNICAL ASSISTANTS in the Gas Works and Production Engineer's Staffs at Glasgow, Dumbarton and Paisley.

The salary scales will range from A.P.T. 6 to A.P.T. 10 (Provincial A) Grades with placing therein according to experience and qualifications.

Candidates should possess, by examination, a recognised qualification in Engineering, Chemistry or Fuel Technology and should be experienced in the operation and control of Gas Works or similar types of plant.

The posts are pensionable and the successful candidates will be required to undergo medical examination.

Applications, endorsed TA stating age and giving particulars of training, qualifications and experience and with particulars of present salary should be addressed to the Personnel Officer, 9, George Square, Glasgow, C.2, to arrive not later than 14 days after the publication of this notice.

SCOTTISH GAS BOARD

ASSISTANT INTERNAL AUDITORS

APPLICATIONS are invited for two vacancies for ASSISTANT INTERNAL AUDITOKS. Preference will be given to applicants holding a recognised accountancy qualification, but candidates should hold at least a qualification equivalent to the intermediate level of a recognised accountancy body. The successful applicants will be based in Glasgow and will be required to carry out auditing duties in the Board's Glasgow and Western Division.

Salary scale—£705-£825 per annum with placing according to qualifications.

The posts are pensionable and the successful applicants will be required to pass a medical examination.

Applications stating age, and giving details of education, training, qualifications and experience, together with the names of two referees should be sent to the undersigned within 14 days of the appearance of this advertisement.

A. T. HERD,
Secretary.

26, Drumsheugh Gardens,
Edinburgh, 3.

May 16, 1957.

SCOTTISH GAS BOARD

EDINBURGH AND SOUTH-EASTERN DIVISION
SENIOR HOME SERVICE ADVISER

APPLICATIONS are invited from qualified persons for the post of SENIOR HOME SERVICE ADVISER in the Edinburgh and South-Eastern Division. The duties of the post will include taking charge of a small staff of Home Service Advisers and generally organising the work of the Section within the Service and Sales Department. The salary will be within the range of Special Scale V, £453-£580 per annum with placing according to qualifications and experience of successful candidate.

The position is pensionable and the successful applicant will require to pass a medical examination.

Applications stating age, and giving particulars of education, training, experience and qualifications should be addressed to the General Manager, 15, Calton Hill, Edinburgh, 1, not later than Monday, June 10, 1957. All applications will be acknowledged and are confidential.

DAVID BEAVIS,
General Manager.

FORD MOTOR COMPANY, LTD., have a vacancy for an ENGINEER, age 26-35, in connection with a modernisation scheme for their Coke Oven plant. Applicants should have had drawing office experience in the design and layout of modern coke ovens and by-product plant in an engineering capacity at such or in the chemical engineering industry. This is a well paid post, with participation in a generous non-contributory pension scheme. Please send details of experience and qualifications to Salaried Personnel Department, Dagenham, Essex, quoting reference MEP.

Amended Advertisement.

EAST MIDLANDS GAS BOARD

LINCOLNSHIRE DIVISION
APPOINTMENT OF GROUP ENGINEER—GRIMSBY

APPLICATIONS are invited from Corporate Mem- bers of the Institution of Gas Engineers for the position of GROUP ENGINEER, Grimsby.

Grimsby Works consist of Woodall-Duckham Continuous Vertical Retorts and carburetted water gas plant with a nominal daily output of 5¼ mill. cu.ft. Candidates should have had extensive experience of the above types of plants and in the control of staff and labour.

The commencing salary will be within Group B (£1,105/£1,265 per annum) of the National Salaries Table for Senior Gas Officers, according to qualifications and experience.

The post is pensionable and the successful applicant will be required to pass a medical examination.

A house in a good residential area will become available on reasonable terms under a Service Occupation Agreement, if required.

Applications stating age and giving particulars of education, training, experience and qualifications, together with the names of two referees, should be sent to the Divisional General Manager, Belle Vue House, Carline Road, Lincoln, to arrive not later than June 10, 1957.

A. GWYNNE DAVIES,
Secretary

Beverley House,
University Road,
Leicester.

May 20, 1957.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION
ASSISTANT CHEMIST

THE position will be tenable at one of the Works in the Division and requires a minimum qualification of Inter. B.Sc. or National Certificate in addition to experience of chemical control of plant.

The salary will be within A.P.T. Grade 7 (£705-£785 per annum) of the National Salary Scales for Gas Staffs.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating personal details, particulars of training and qualifications, together with the names of two referees, should be sent to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Gas Offices, Edmund Street, Birmingham 3, to reach him not later than June 3, 1957.

K. W. NEVETT,
Industrial Relations Officer.

WEST MIDLANDS GAS BOARD

WORCESTERSHIRE & HEREFORDSHIRE DIVISION
TECHNICAL ASSISTANT, KIDDERMINSTER DISTRICT

APPLICATIONS are invited for the above appoint- ment from candidates conversant with gasworks routine tests, and preferably having experience of continuous vertical retorts and carburetted water gas plants.

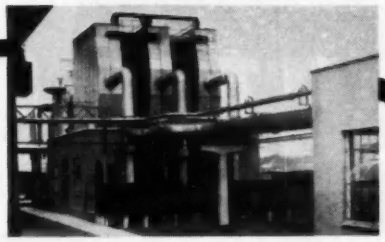
Possession of the Ordinary Grade Certificate in Gas Engineering will be an advantage.

The salary for the post will be in accordance with A.P.T. Grade 5 (£605-£685 per annum) of the National Salary Scales.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications stating age, education and experience, together with the names of two referees, should be addressed to C. F. W. Rendle, Esq., Divisional General Manager, West Midlands Gas Board, Newtown Road, Worcester, to reach him by not later than June 3, 1957.

K. W. NEVETT,
Industrial Relations Officer.



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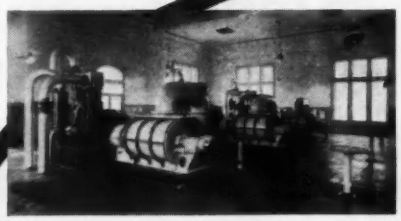

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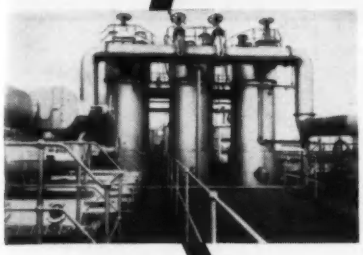

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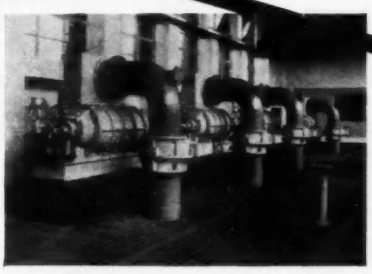

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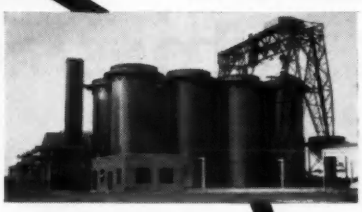

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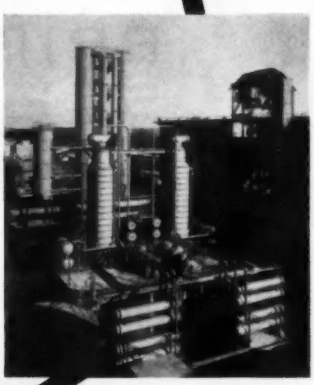
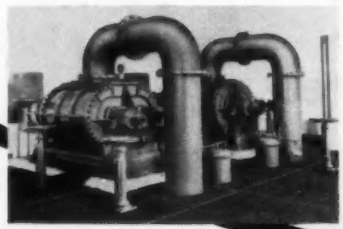


BENZOLE RECOVERY PLANT



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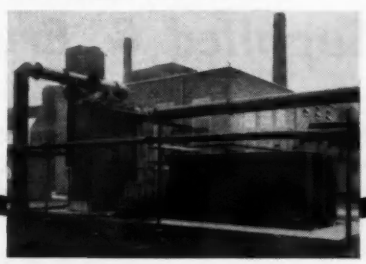
GAS DEHYDRATION PLANT



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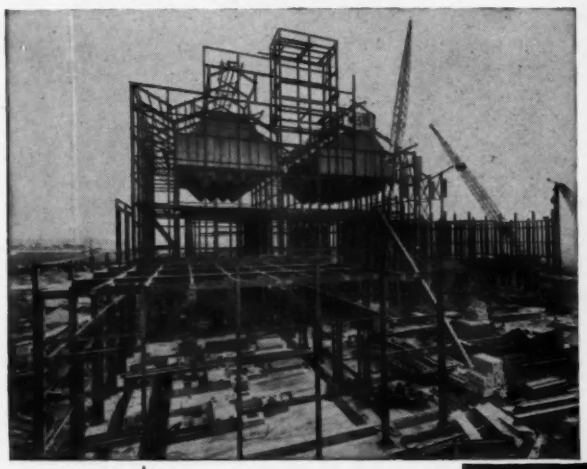

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Reading	**3·5 million cu. ft./day**
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München Gladbach	**1·2 million cu. ft./day**

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